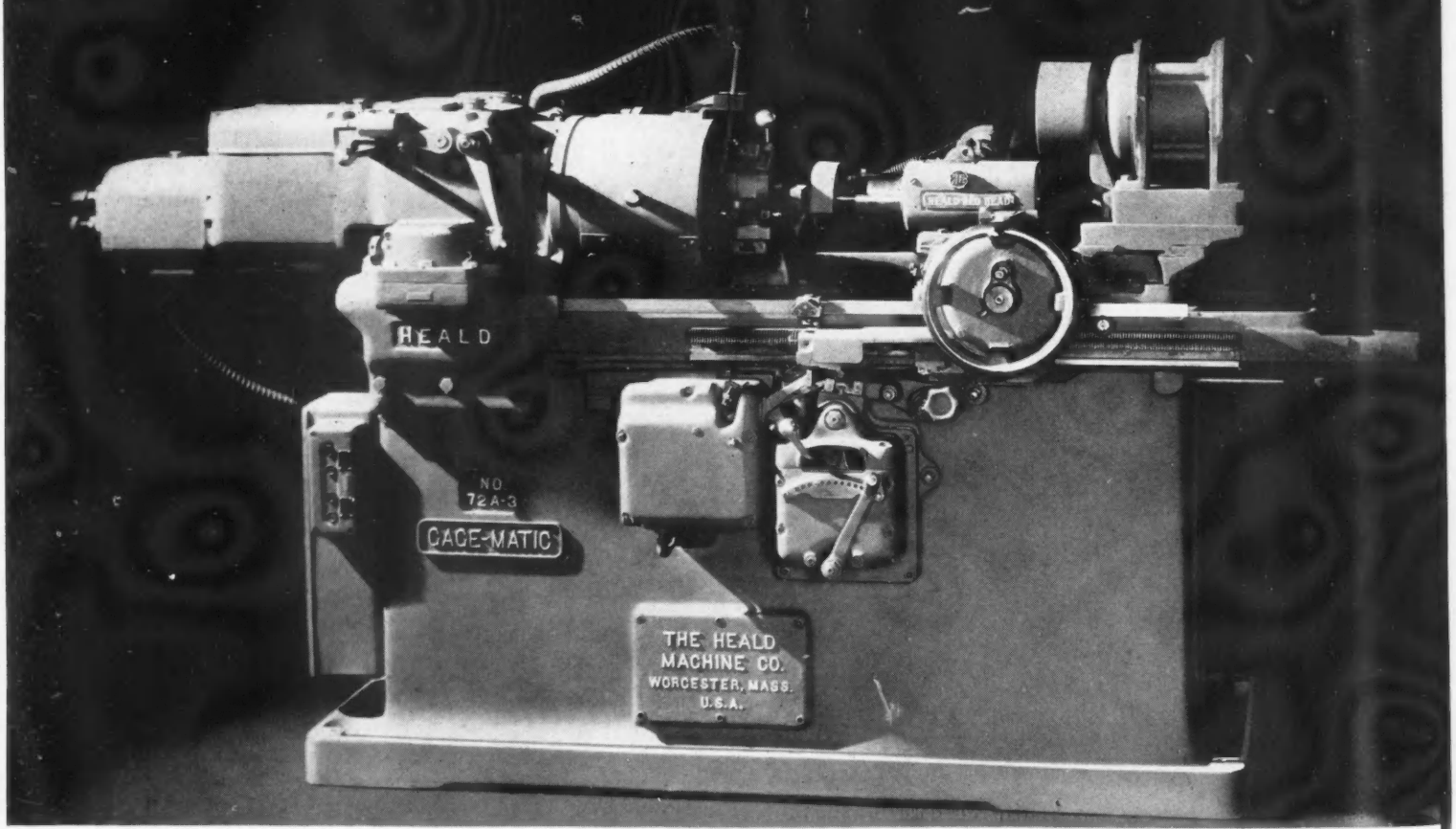
AUTOMOTIVE and Aviation INDUSTRIES

FEBRUARY 15, 1943

ON THE NOSE EVERY TIME

EVEN WITH AVERAGE OPERATORS



Thanks to Automatic Internal Grinding

You're bound to do better and faster grinding with Heald Automatic Internals – they're so easy to operate even for average operators. In fact, Heald Gage-Matics and Size-Matics almost operate themselves, because they are completely automatic except for loading and starting the machine. Their automatic features include automatic grinding to semi-finish size, automatic wheel truing, and automatic grinding to finish size. As a result, these machines make possible uniform accuracy with minimum scrap and reduce operator fatigue. With such features Heald Gage-Matic and Size-Matic Internals are almost human in operation and literally talk production. They'll talk any grinding job into higher production and closer accuracy. Complete information on request.

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AUTOMOTIVE and Aviation INDUSTRIES

Published Semi-Monthly

Volume 88 — February 15, 1943 — Number 4

CONTENTS

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Foreman checks hardening temperature by glance at the furnace's Micromax Controller.

MAKING MACHINE GUNS With Help of Micromax Pyrometers

The control of temperatures in such heat-treating operations as homogenizing, normalizing, hardening, cyaniding, annealing, tempering, etc., is handled on scores of furnaces by Micromax Pyrometers in the vast machine-gun works of John Inglis Co. Ltd., Toronto. Tens of thousands of Colt Browning, Bren and Boys guns are leaving the Inglis plant, heat-treated by operations such as these:

Cyaniding: Pot furnaces are arranged on both sides of a central aisle. Each has a Micromax Controller right alongside, where the operator can always see it. Some of these Controllers are round-chart and others strip-chart; some use on-off control and others require full-floating, proportioning Micromax Electric Control. In any case, control is fully automatic and the Controller's micro-responsiveness and dependability help the operator to do a good job, and show the foreman its quality.

Homogenizing or grain-refining: Rough-forged gun barrels are heated in oil-fired furnaces and quenched in revolving-fixture machines, to refine the grain before being annealed, rough-turned and bored. Furnace operators are on the jump, loading the furnace and the quench machine; they never give a thought to temperature control of the furnace. But the foreman has only to set the strip-chart Micromax, and it faithfully carries out his orders. . . . Furnaces for gun-frame forgings discharge these parts directly into a quench tank. Operators thus never see the hot forgings, and so have no occasion at all for concern about furnace heat; but again the Controllers maintain temperature as "instructed" by the foreman.

This ability of a Micromax Pyrometer to carry on without attention is principally due to its automatic and semi-automatic self-servicing features. It standardizes its own measuring circuit; shows a warning if its electric power is cut off; signals far in advance of its infrequent needs for ink, chart and dry batteries. Its record is extremely easy to read.

For information about ranges, models, etc., see Catalog N-33A, Micromax Thermocouple Pyrometers, or N-33B, Micromax Rayotube Pyrometers.

Quick Delivery Of Metal-Saving Tubes For Thermocouples

To help save metal in the present emergency, we can now supply tubes made of "Fyrestan" ceramic ware, to replace, wherever desirable, the iron, steel and alloy tubes which protect base-metal thermocouples. Fyrestan has long been our standard for temperatures too high for alloys, and we hope that its availability for use in the alloy range will now give many firms an opportunity to reduce the number of metal tubes they require.

An additional reason for adopting Fyrestan wherever possible is that it can usually be shipped much more promptly than metal tubes.

Fyrestan is of course not as strong as metal, but it is fully as gas-tight. Its life in service is comparable with that of metal, and in some instances, in the range 1800 to 2000 F, it should outlast an alloy. In general, it can be used for all applications except the following:

1. Immersion in molten metals
2. Immersion in certain molten salt baths
3. Where unsupported length exceeds 36" vertically or 18" horizontally
4. Where work in furnace may strike tube
5. Where tube is withdrawn frequently
6. Where furnace pressure is more than 1 lb. per sq in.

When you need tubes, ask about Fyrestan. And if you have any of our "live" quotations, made before Fyrestan was available, we'll be glad to requote on the basis of Fyrestan.

Foreman and heat-treater consult Round-Chart Micromax Controller before changing charge in cyaniding pot.

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IN THIS ISSUE . . .

AUTOMOTIVE and AVIATION INDUSTRIES

Volume 88 February 15, 1943 Number 4

AUTOMOTIVE INDUSTRIES

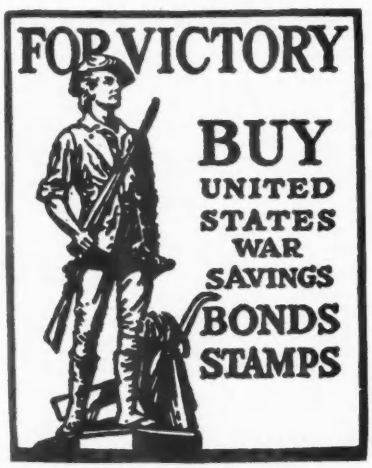
Reg. U. S. Pat. Off.

Los Angeles Sets Good Example

Conversion of small industrial plants in Los Angeles County to war production units was a success in the aircraft subcontracting and supply field last year.

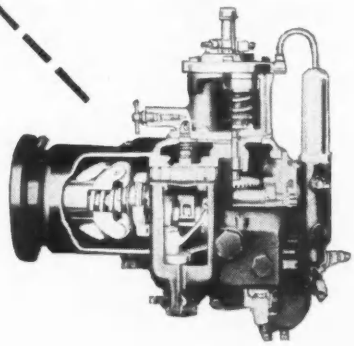
Between Jan. 1, 1942, and Jan. 1, 1943, the Los Angeles County Chamber of Commerce aviation department reported the number of plants in this county supplying major warplane factories with accessories, parts, materials and machinery jumped from 275 to 866. This gain of 591 represented an average of 49 plants a month converted to war work, or an average of more than one and six-tenths plants each day.

The switchover from peacetime goods to war goods got off to a slow start, with only 40 plants converted in the first four months of 1942. From the beginning of May on, however, there was a swift change of pace, and in the final eight months of the year 551 concerns took over war work. This was an average of 69 plants a month or more than two and two-tenths plants each day.



SECRET POWER FOR WAR-TIME DIESELS!

★ The tremendous power of modern diesels depends upon many hidden features. In the combined fuel pump and governor unit of the Cummins Engine, for example, are several especially designed springs. These springs, fabricated by Muehlhausen, are to a large extent responsible for the smooth performance of the engine under greatly varying loads. They help to provide the sudden bursts of power required as a huge shovel bites its way through mountains—or the steady flow that enables multi-ton trucks to churn through the gumbo of wilderness roads. If your product has a tough spot for a spring of any type—compression, extension, torsion, or flat—consult MUEHLHAUSEN SPRING CORPORATION, 650 Michigan Ave., Logansport, Indiana.



MUEHLHAUSEN SPRINGS

EVERY TYPE AND SIZE

FREE! SEND FOR INFORMATION

- New Die Spring Bulletin illustrates, describes 206 sizes and types of die springs.
- New Armament Bulletin shows importance of springs for many types of war equipment.

AUTOMOTIVE and AVIATION INDUSTRIES

Published on the 1st and 15th of the month

Vol. 88, No. 4
February 15, 1943

Interchangeability of Parts for Army Vehicles Is Next Objective

By E. L. Warner, Jr.

SIMPLIFICATION and standardization of parts for Army trucks and combat vehicles is something greatly to be desired, especially from a maintenance viewpoint. But the exigencies of war have required tremendous production of military vehicles in the last two years—for lend-lease shipment, for U. S. task forces abroad and for military use in this country. The primary aim has been to get as many serviceable vehicles into action as quickly as possible, with little regard for uniformity in types and sizes. This has provided the needed motorized transportation, but it did increase the complexity of the maintenance problem. There are so many types of vehicles and then so many varying makes of parts within the same vehicle model that a streamlining of the vehicle and parts programs is regarded as a necessary objective.

As an example of this need for simplification, in the present series of 14 tactical motor trucks there are eight different types of generators, 11 kinds of starters and 11 types of batteries. Inasmuch as a distributor functions the same on any six-cylinder engine, the Army believes that the eight types of distributors can be reduced to two or three. Similarly, they believe that spark coil types can be cut from six to two. Ten types of starting gears represent duplication when five might serve the purpose. Likewise, there are 10 different air cleaners, a dozen varieties of clutches and other examples of multiple parts where a few might serve.

The simplification problem is not so acute among the large volume vehicles. Ford and Willys-Overland standardized on the ¼-ton jeep, Dodge developed the ¾-ton truck and Chevrolet became the principal maker of 1½-ton 4 x 4 trucks. In the 2½-ton 6 x 6 classification, which is the Army's biggest production vehicle, General Motors Truck was the principal manufacturer. But when orders pyramided, additional facilities had to be obtained, so Chevrolet and Studebaker were brought into the 6 x 6 truck program. This required more sources for axles and transfer cases, so another supplier making a different product was obtained for these components. This was necessary for volume output but it worked against simplification.

The simplification problem is particularly needed in the heavy and special truck groups above 2½ tons in capacity. Only 3½ per cent of U. S. truck output in 1939 was in the 3½-ton and upward group. This had expanded to 5.2 per cent of total truck output in 1940 and 7.3 per cent in 1941 as increasing Army truck orders boosted the percentage. However, this production is spread among a number of smaller

(*Turn to page* 76)

Stromberg Injection Carburetor

Production

ALTHOUGH not publicized, for good and sufficient reasons, the development of military airplane carburetors in this country has been crowned with exemplary success due to the collective efforts of our American aircraft engineers and carburetor producers. As a result, our fighting airplanes have the world's best fuel handling equipment, far superior to the older types and much less complex than the German multiple-injection system.

Without encroaching upon the restricted features of airplane carburetor design, it is our object to provide a picture of the manufacture of the Stromberg injection carburetor by the Bendix Aviation Corp. Behind the scenes of the present development program are years of intensive research carried on under the capable direction of Frank C. Mock, well known as one of the outstanding carburetor specialists in this industry. Mr. Mock has been identified with Stromberg carburetor development since 1912. So far as airplane carburetor development since World War I is concerned, it can be said that Stromberg was practically alone up to about 1935 in its efforts to provide the flying services with constantly improved fuel-handling equipment in keeping with the advances in military airplane design.

From the relatively modest scale of production that prevailed only a few years ago, the demand for Stromberg airplane carburetors has approached such levels as to place their manufacture on a mass-production basis. At this writing Bendix has in operation three additional carburetor plants besides the parent operation in South Bend. These facilities, in turn, are supplemented with sub-contractors who manufacture many of the small components.

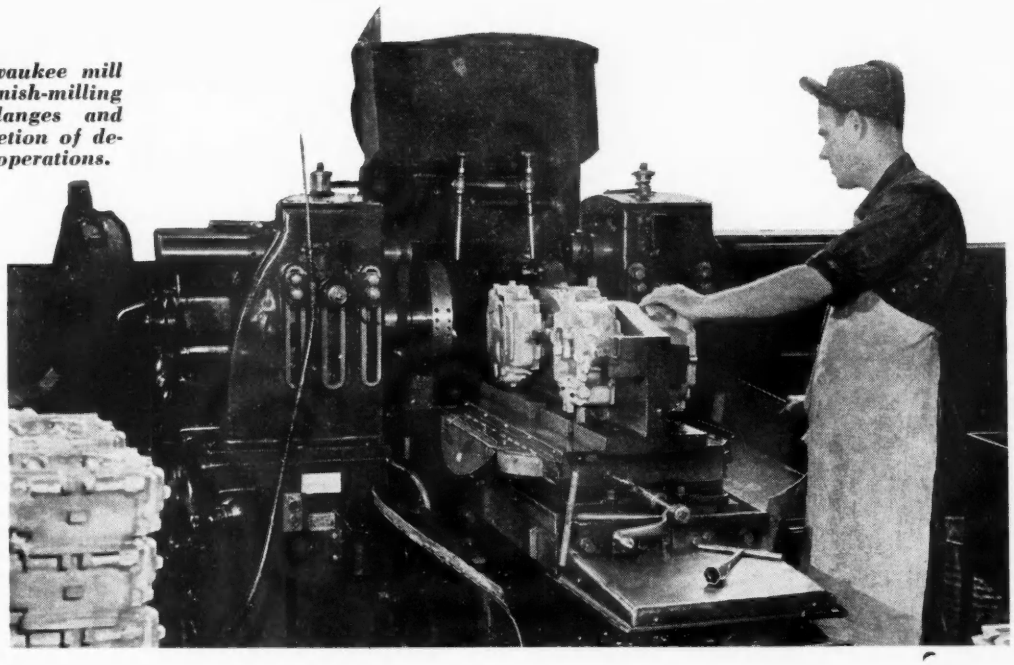
Of course, the production of military airplane carburetors is not exactly mass-production procedure despite the volume of demand. For example, Stromberg has in active production no less than fifty different types of injection carburetors, embodying a multiplicity of variations due to differences in engine characteristics for different airplanes, in applications due to differences in mounting and controls, and so on. All of these variables make it necessary to treat carburetor production on a glorified job-lot basis, save for such components as are unaffected by these variations.

Another thing that complicates the situation at the moment is the transition from aluminum to magnesium for the carburetor castings. At the present time Stromberg uses aluminum sand castings, aluminum permanent mold castings, and magnesium sand castings. Ultimately, it is expected that all of the throttle body castings will be made of magnesium.

Many of the aluminum sand castings are made in a self-contained foundry department adjacent to the machine shop in the South Bend plant. This is a complete small-scale operation employing dry-sand molding methods. Molding and pouring are handled on a mechanized merry-go-round conveyor line. A feature of the foundry, stemming from the early days of this development, is the use of X-ray analysis of throttle body castings to assure perfect sound-

View in the aluminum foundry department. This shows the merry-go-round pouring conveyor, with dry-sand molds for throttle bodies and adapters ready for pouring.

This Duplex Milwaukee mill is used for the finish-milling of carburetor flanges and faces after completion of detail machining operations.



By Joseph Geschelin

on Large Scale

to Military Demands

ness in every respect. Throttle bodies are X-rayed, as necessary, in some cases 100 per cent, before they are approved for machining.

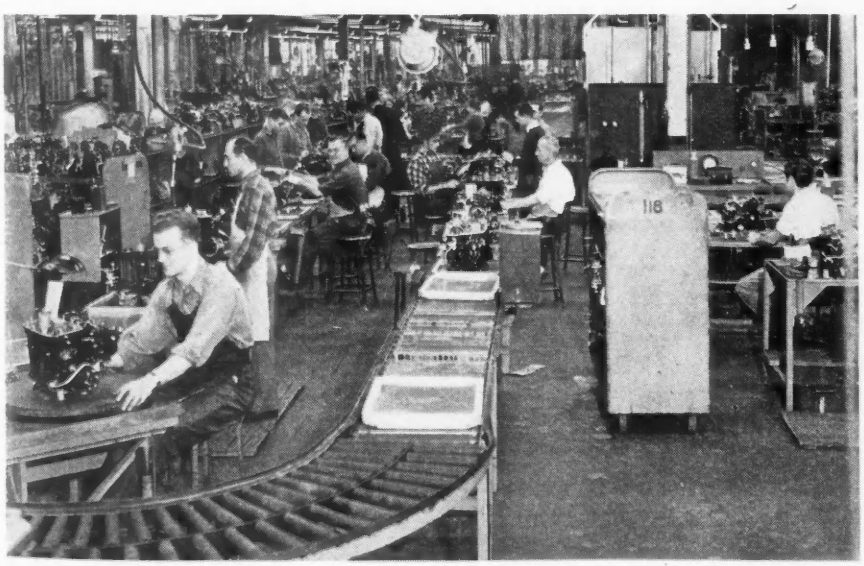
Generally speaking, the Stromberg airplane engine carburetor consists of the following major elements:

throttle body
adapter—depending upon engine installation
fuel control unit
pressure regulator
automatic mixture control attachment

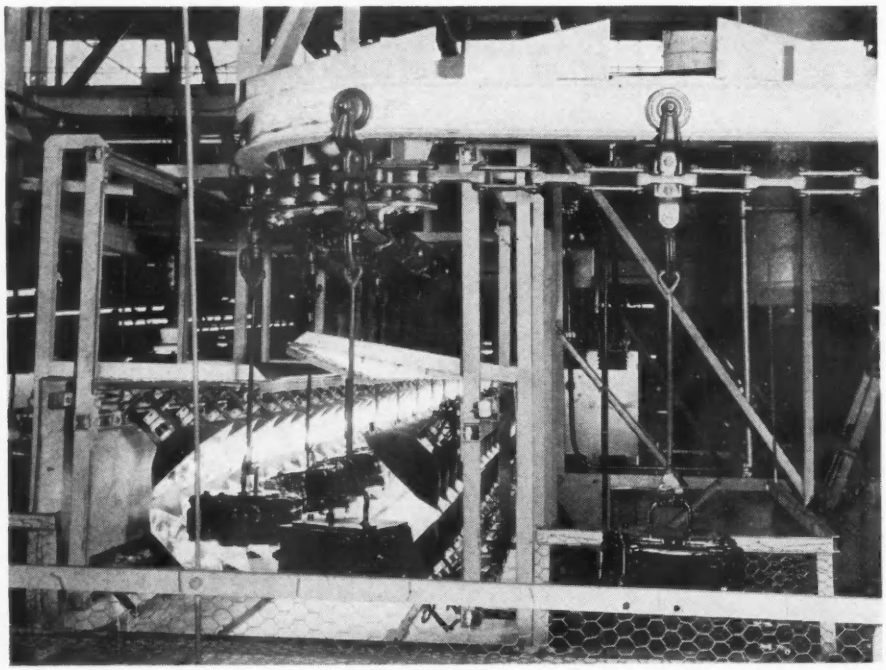
In the interest of simplification of manufacturing operations, Stromberg machines chiefly throttle bodies and adapters, and draws largely upon its sub-contractors for attachments or components which are made up into sub-assemblies. The South Bend operation handles about 20 to 25 different variations out of the fifty or more types in active production.

Consequently, the factory operation here is quite simple. It comprises a modest machine shop layout; and, naturally, a large assembly department served by an impressive air-box installation for final inspection.

Among the most important items of machine tool equipment found here is a large Milwaukee Duplex milling machine set-up for straddle milling throttle bodies. This machine is fitted with an indexing table, permitting the loading and unloading of work without interrupting the machining cycle. Another impressive piece of equipment is a large Natco multiple-spindle drill which has been converted to serve as a heavy-duty boring machine. This machine has an indexing table with three stations; one station takes the work under the



A glimpse of the Wiring Department where the fastenings are securely locked.

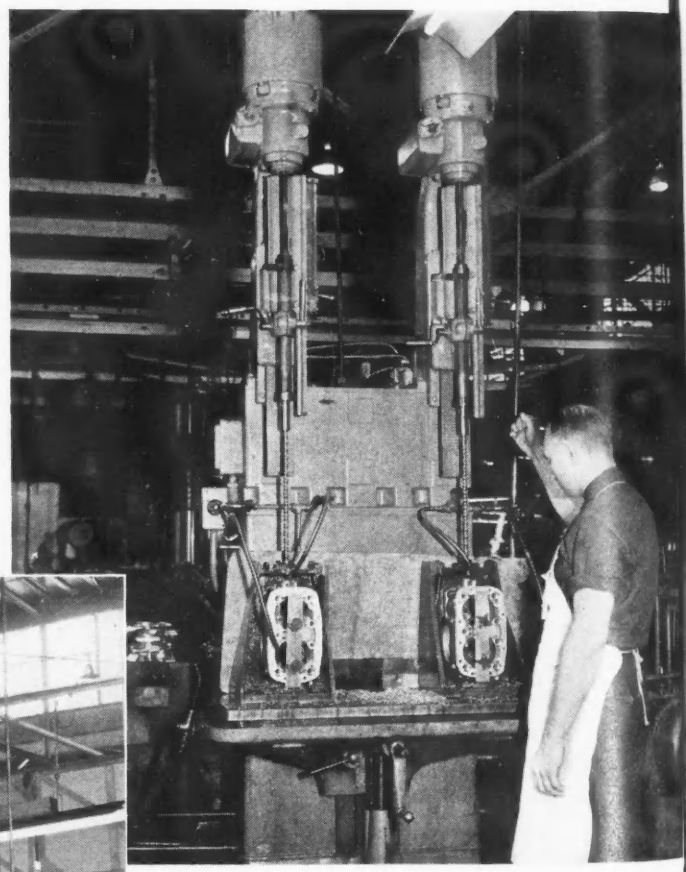


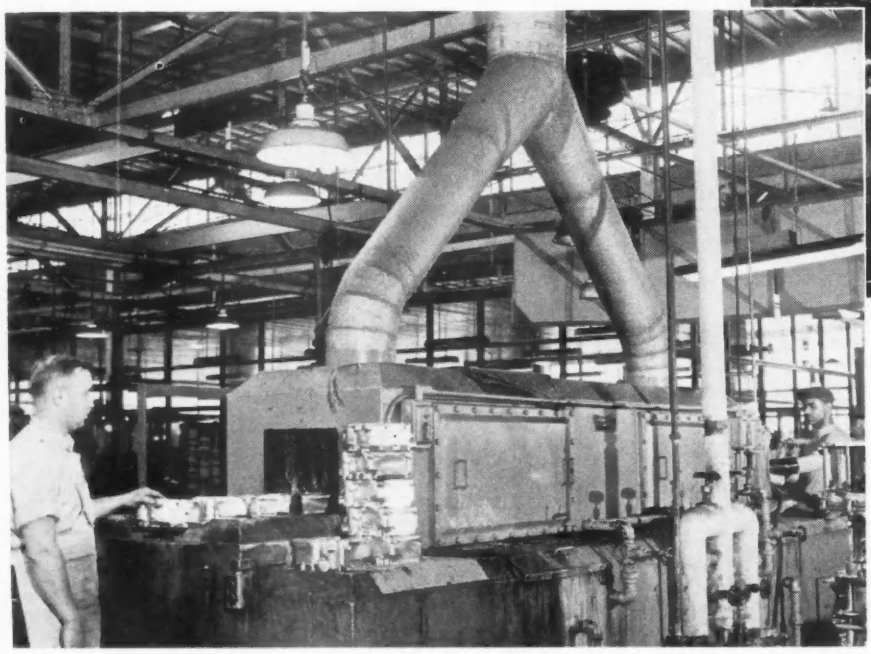
View of the ceiling-mounted Infra-red lamp baking oven for drying throttle bodies. Note how the housings are transported on the overhead monorail line.

rough-boring tools; the second, under the finish-boring tools; while the third is employed for loading and unloading.

It may be noted at this point that cemented-carbide tools are used exclusively for all boring and milling operations, many of these tools being supplied by Carboloy. This follows from the experience that aluminum and magnesium are cut most rapidly and efficiently by the special grades of cemented-carbides. In addition, the Bendix factory management has developed a special cutting fluid mixture which has given great satisfaction. This mixture consists of 60 per cent kerosene or fuel oil (now used almost exclusively), 20 per cent lard oil, and 20 per cent of cutting compound supplied by International.

The most advanced technique adopted here recently is the use of the well known Cincinnati Hydro-Tel machine. Two of these machines are found at South Bend: one for rough finishing the large square or rectangular bores in certain types of carburetor bodies; the other for finish-boring to size. The Hydro-Tel method makes a mass-production job of an operation that would otherwise require a mul-





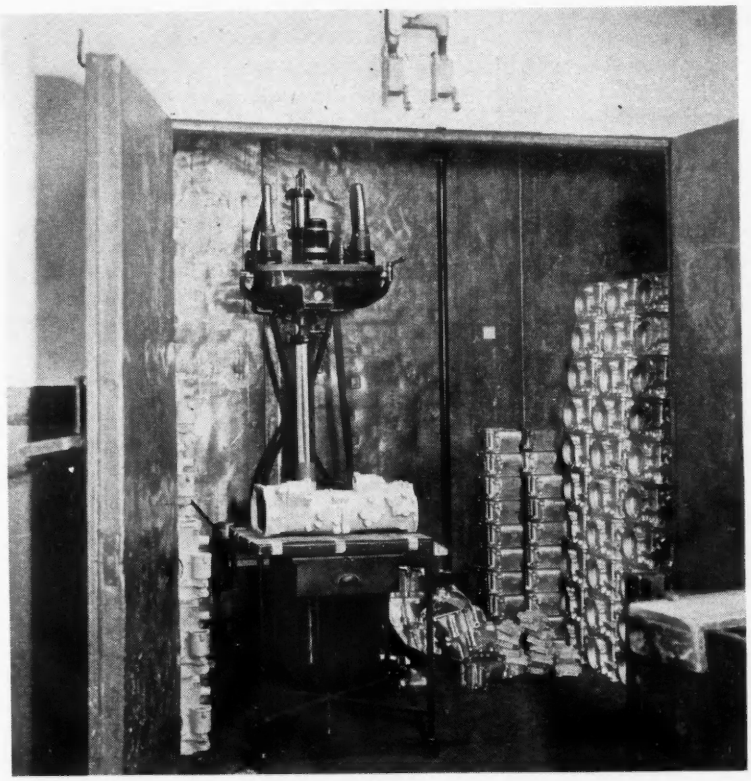
(Above) Two-spindle, Baker deep drilling machine is used for drilling long galleries in the throttle body.

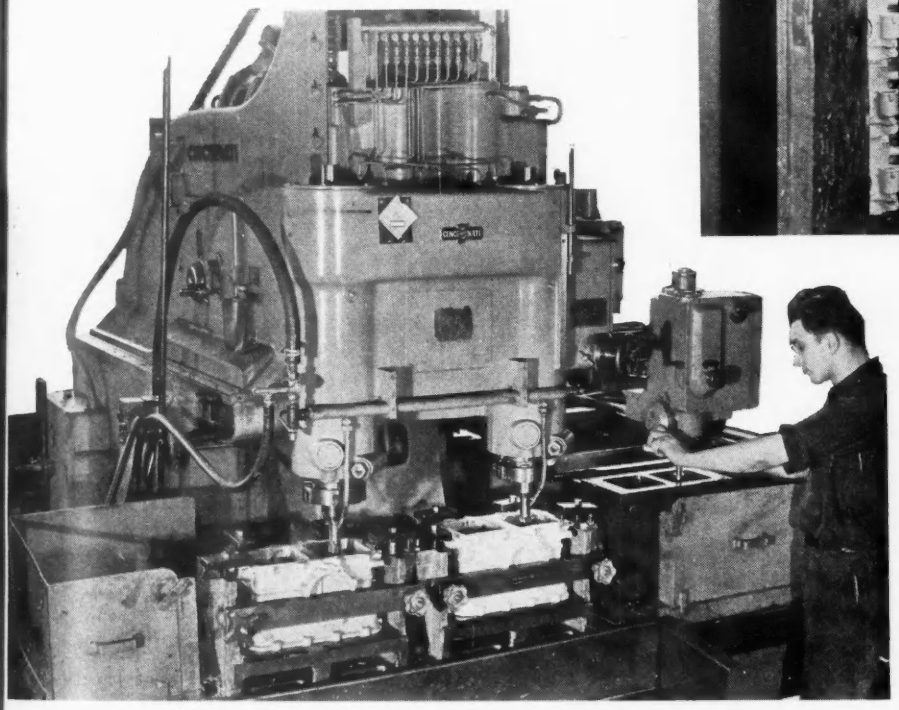
(Left) Detroit Rex washing machine, one of a number of similar units in the carburetor division used for cleaning carburetor bodies and flanges.

tiplicity of boring, drilling, and shaping operations.

Apart from boring, milling, and Hydro-Tel operations, the major work is done on drill presses — Natco multiple-spindle drills, Baker deep-hole drilling machines, Leland-Gifford rifle-drilling machines, and the well-known Edlund single-spindle drillers and tappers.

Excellent example of deep-hole drilling is found in the two-spindle Baker drilling machine which is illustrated elsewhere in this article. Natco multiple-spindle drilling machines with indexing tables of various forms also are liberally used for gang drilling operations. An interesting feature of the machine shop is the double row of Edlund single spindle drills, illustrated here.





(Above) Interior of one of X-ray booths in the carburetor department. Each throttle body is radiographed to assure perfection of casting quality.

(Left) One of two Cincinnati Hydro-Tel machines used for rough- and finish-profiling of square-shaped throats in large carburetor bodies.

Experience at Bendix has shown that the relatively soft aluminum and magnesium castings can be readily damaged in handling at the various stages, no matter how carefully such work is done. Consequently, the major operations of milling the flanges and boring on the Natco and Hydro-Tel, are done in two separate stages. The first stages, mentioned above, are in reality roughing operations. In each instance, about 1/32 of metal is left for finishing after the major machining has been completed. Then the flanges are milled to size on Kearney & Trecker milling machines; the round bores are re-bored to size; and the square bores finished to size on another Hydro-Tel. This removes all surface imperfections due to handling and clamping in fixtures, produces a product of exceptional quality.

Following the practice common in all airplane parts establishments, there is found a large burring department in which all of the machined parts are filed and polished and burred, using hand tools. It is of interest to find that a throttle body requires, on the average, about an hour of work in this department to produce an acceptable character of finish.

Immediately following the preliminary machining operations, the housings are cleaned by washing in a Detroit Rex hot-water washing machine. A similar unit is employed prior to the corrosion resistance treatment.

After machining, all aluminum and magnesium castings are given a suitable corrosion-resistance treatment in the electro-chemical department. Aluminum castings are anodized; magnesium castings are given the dichromate bath treatment.

Following this chemical treatment, the housings go to the paint department for the final finish. The latest development here is the installation of a monorail paint conveyor for transporting the housings through the paint spray booths. After spray-painting the housings continue on another stage of the monorail conveyor through an overhead-mounted baking oven. The latter employs a large bank of infra-red lamps, aids in

reducing the drying cycle to but a fraction of the time required by conventional methods formerly used.

From this point on the components of the carburetor are ready for subassembly and final assembly operations. First stage is the subassembly of the throttle body. This includes minor repairs and corrective treatment; installation of bushings and other small parts.

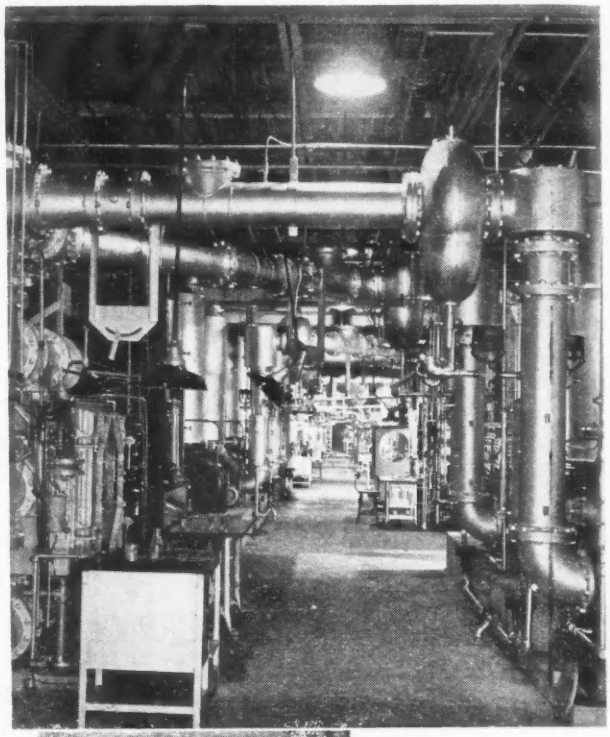
This takes us to the final assembly department. Here will be found assembly stations for each of the subassemblies—the throttle body, fuel control unit, pressure regulator, automatic mixture control. Each of the subassembly groups employs Thor high-frequency portable tools and is provided with suitable fixtures and instrumentation. The fuel control unit, which is one of the major elements of the carburetor, is adjusted to precise settings by checking on special flow benches provided for the purpose. These settings control the fuel-metering characteristics of the carburetor and are later re-checked in the air-box.

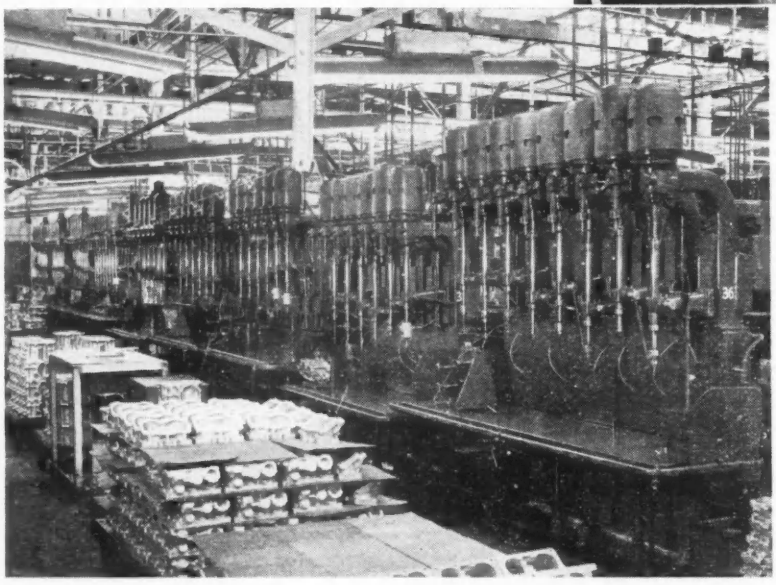
Final assembly marks the integration of all the attachments and fittings that make up a complete injection carburetor unit, ready for flight. Here the throttle body is fitted with the adapter, fuel control unit, pressure regulator, automatic mixture control, and the multiplicity of rods and levers and tubing.

Such assemblies, after inspection, are ready for the crucial test in the air-box department. The latter is housed in a long bay, contains many of the air-box units developed and tailor-built by Bendix for the purpose. In the air-box test, each carburetor is put through its paces under simulated flight conditions. The carburetors are painstakingly checked for adjustment, for air-fuel flow for various throttle positions, and for performance in simulated high altitude flying. The history of each carburetor is preserved for ready reference.

It might be expected that the carburetors completing the intricate schedule outlined

(*Turn to page* 88, *please*)





(Above) Interesting example of improvisation at Bendix: this Natco multiple spindle drill converted to a boring machine for boring airplane carburetor throats. Note the three station fixture—the first is for loading and unloading; the second for rough boring; the one at the extreme right for finish-boring.

(Top) Here is a view looking down the final carburetor testing department, showing a large battery of Bendix-designed air boxes.

(Left) View of one side of a large drilling department bay, showing one of two rows of Edlund single-spindle drills.

Along the mechanized assembly line at Vultee's Nashville plant a position chart is located at each station to guide workers.

Position Charts

Guide Inexperienced Workers at Vultee

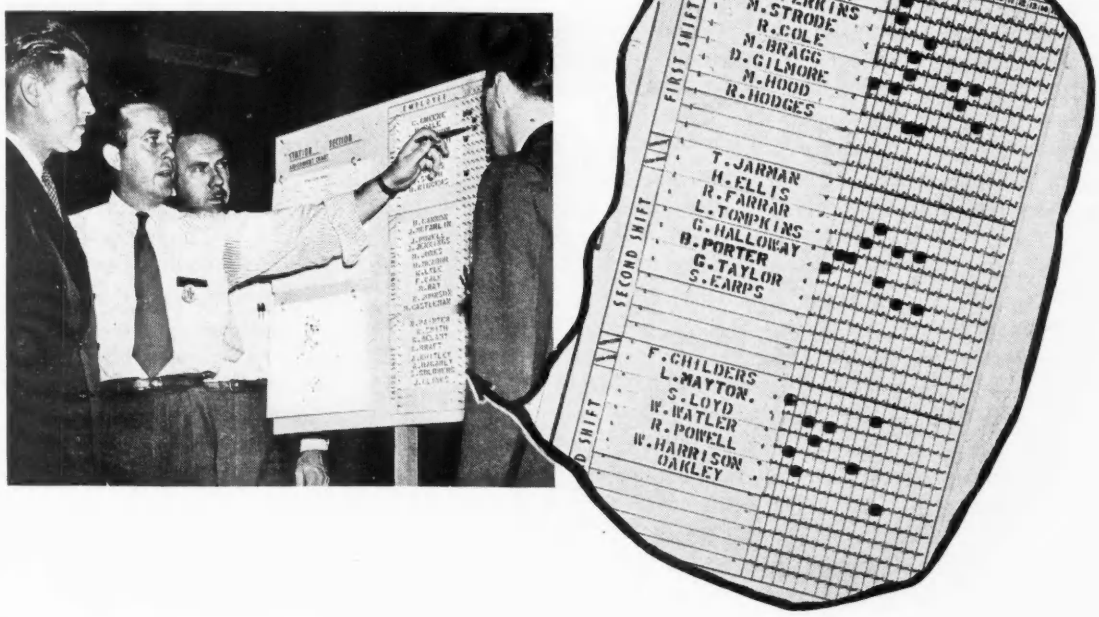
DURING the past year literally thousands of totally inexperienced workers have been absorbed into the aircraft industry just when the pressure was being placed on greater and greater production, and every plant manager and every methods engineer has been faced with that problem. At the Nashville plant of Vultee, Inc., a plan has been worked out by the Methods and Control Department to help inexperienced workers fit into the accelerated schedules in effect since production has gone on a mechanized basis.

Recently a system of position charts was set up throughout its assembly departments. Known as the "Victory Boards," these charts are proving to be of inestimable value in helping new employes to get the information usually obtained from the foreman, or leadman, or through a dozen other channels. One of the chief conveniences of the charts over the old system is that the charts are always available immediately.

The charts were designed to give the following information: Show the work location, describe each job in detail with pictures or drawings included for the further assistance of the worker, call out needed parts involved, and show the source of the parts. In addition, a list of the tools required is included in the chart along with the standard time for the job and the inspection requirements.

Every worker at a given station on the assembly line has a name plate, which is posted on the chart beside a numbered list of the jobs at his station, which in turn is keyed to the master sheet. A quick glance at the red disks hung beside his name tells a worker just what jobs have been assigned to him for the day.

Supervisors, workers, and inspectors all agree that the charts supply at a glance information that used to be handed on in literally hours of verbal instruction. One of the most popular features of the boards is the drawing or photograph of the parts involved. Through reference to these aids a new employe is able to see what the finished job he has been assigned should look like. Parts are named and any unusual features pointed out. Quick reference to the photograph or drawing saves countless questions and time.



Here plant officials are analyzing a position chart, which consists of an employe roster, a positon sheet and an illustration. The employe chart at the right lists the workers, including the inspector and leadman, and indicates the jobs assigned to them. The position sheet (upper left) gives a breakdown of each job, consisting of the numbers and names of the parts, tools required, and a detailed explanation of the operations. The illustration (lower left), shows the assembly, the parts indicated by their names and numbers.

Aeronautical Engineers

DIGRESSING from its past custom, the Institute of Aeronautical Sciences this year held its Eleventh Annual Meeting in three industrial centers of the country—New York, Detroit and Los Angeles. There hundreds of technical specialists and executives of the aircraft industry, and representatives of Army, Navy and Government war agencies assembled during the last week of January to study new developments in the aviation field and to exchange engineering and manufacturing experiences. Attendance at the New York sessions exceeded the record set last year, when the meeting was limited to that city.

Among the developments presented at the technical sessions were the application of radio-frequency energy for case hardening steel and as a heat source in plywood manufacture, an engine horsepower meter for installation on airplanes, a method of design-strengthening sheet metal without increasing its unit weight, a flight plan analyzer-altitude selector for airline pilots, a new electrical-control system for radio control of vehicles, a multiple automatic recording manometer for wind-tunnel testing, a remote-reading airplane compass, an automatic plane-to-ground radio transmission system for recording flight test data, new mathematical equations for aircraft maneuverability and a tabular trial-and-error method for quick evaluation of propeller blade bending stresses.

In addressing the New York meeting, T. P. Wright, director of the Aircraft Resources Control Office of the War Production Board, stated that now 25 per cent of the workers in the aircraft industry are women, and that by summer the figure would be up to 40 per cent. He pointed out that not only had the production of airplanes increased rapidly from 1940 on, but in the three years also, the average product weight went up in a 1—1.25—1.75 ratio. Air Vice Marshall F. W. MacNeese-Foster, of the Royal Air Force, now attached to the combined chief of staff in Washington, predicted that the aircraft output in England this year would be 25 per cent greater than it has been.

Igor I. Sikorsky, engineering manager, Vought-Sikorsky Aircraft Division of the United Aircraft Corp., received the Sylvanus Albert Reed Award for his "creation and reduction to successful practice of a helicopter of superior controlability." Other honors were given as follows:

JOHN JEFFRIES AWARD—to Dr. Edward C. Schneider, professor of biology at Wesleyan University, for his pioneering research in the field of aviation medicine, particularly the development of the Schneider Physical Fitness Index for testing the condition of pilots.

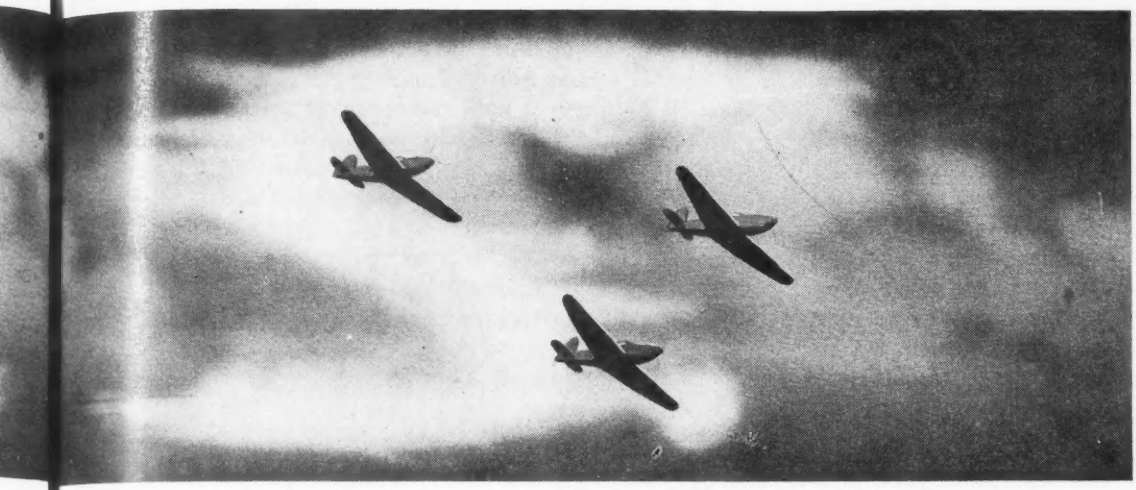
ROBERT M. LOSEY AWARD—to F. W. Reichelderfer, chief, U. S. Weather Bureau, for his pioneering work and continuing activity in advancing the science and practice of meterology as applied to aeronautics, with particular recognition of the development under his direction of the network and system of upper air sounding by radiosonde.

OCTAVE CHANUTE AWARD—to A. Lewis MacClain, head, installation flight test group, Pratt & Whitney Aircraft Division, United Aircraft Corp., for his outstanding contributions as a pilot to the aeronautical sciences.

LAWRENCE SPERRY AWARD—to Edward C. Wells, assistant chief engineer, Boeing Aircraft Co., for contributing to most of the improvements made in the Flying Fortress from its original design eight years ago to its present design.

Honorary memberships in the Institute were conferred upon Rear Admiral John S. McCain, chief, Bureau of Aeronautics, Navy Dept.; W. A. M. Burden, special aviation assistant to the Secretary of Commerce; and T. P. Wright.

Associate Fellows elevated to Fellows were Fredric Flader, chief engineer, Airplane Division (Buffalo Plant), Curtiss-Wright Corp.; Rudolph F. Gagg, assistant to the general manager, Wright Aeronautical Corp.; Paul E. Hovgaard, chief research engineer, The Glenn L. Martin Co.; Clarence L. Johnson, chief re-



By J. R. Custer

s Meet

in three cities to study new technical developments

search engineer, Lockheed Aircraft Corp.; Arthur L. Klein, consulting engineer, Douglas Aircraft Co.; John G. Lee, assistant director of research, United Aircraft Corp.; William T. Schwendler, vice-president and chief engineer, Grumman Aircraft Corp.; T. E. Tillinghast, president, United Aircraft Service Corp.; P. V. H. Weems, Weems System of Navigation, and John B. Wheatley, chief development engineer, The Glenn L. Martin Co.

The business session was held in New York City and at the annual election of officers Dr. Hugh L. Dryden of the National Bureau of Standards was named president to succeed Hall L. Hibbard, vice-president and chief engineer of Lockheed Aircraft Corp. C. S. Jones, Casey Jones School of Aeronautics; P. R. Bassett, Sperry Gyroscope Co.; James H. Kimball, U. S. Weather Bureau; and John C. Leslie, Pan American Airways, were elected to a three-year term on the Institute Council.

Sixty-five papers were presented at 11 technical sessions, covering a wide range of subjects in the fields of power plants, propellers, airplane design, rotating wing aircraft, structures, materials, production techniques, instruments, radio, transport, meteorology and physiological problems. Major contributions in some of the important papers are summarized in the following paragraphs.

Exhaust Valve Design

An investigation to determine the flow characteristics during exhaust blow-down and to develop a rational background for improving exhaust-valve design for automotive and aircraft engines was the basis of a paper by Seng-Chiu Hu, Vought-Sikorsky engineer, who found during his research that by means of some simple modifications to a conventional valve, its flow capacity can be increased at least 25 per cent without changing its diameter. His study led to a series of modifications in valve and seat profiles, such as the stem fillet, edge radii, head enlargements, seat angle, and port approach. The pressure range during the tests extended from the critical pressure to 80 psi.

The optimum valve, he concluded, has a 30-deg seat angle, a head slightly enlarged and rounded at all edges with moderate radii, and is seated on a port shaped as a converging orifice. For a moderately high valve lift having an L/D ratio of 0.3, the flow coefficient was 0.82, which is 94 per cent of that of an ideal orifice with the same net opening area. The maximum useful lift for this optimum valve is about 28 per cent of the port diameter, but for a conventionally-shaped

Officers of the *Institute of Aeronautical Sciences for This Year*

President—Dr. Hugh L. Dryden, chief of the mechanics and sound division, National Bureau of Standards.

Vice Presidents—J. L. Atwood, executive vice president of North American Aviation; E. R. Breech, president of Bendix Aviation Corp.; Sherman M. Fairchild, board chairman of Fairchild Engine and Airplane Corp.; Earl D. Osborn, president of Edo Aircraft Corp.; Lester D. Gardner (executive vice pres.), president of Aeronautical Archives.

Treasurer—Elmer A. Sperry, Jr., Sperry Products, Inc.

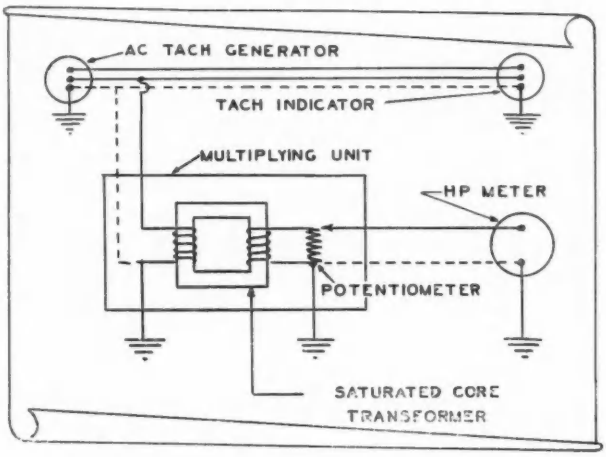
Secretary—Robert Dexter.

valve the lift should be made as high as feasible, as the flow coefficient increases steadily with the valve lift, up to an L/D ratio of 0.45. An aircraft-engine exhaust valve designed for sea-level conditions and showing efficient performance during ground test should remain so regardless of flying altitude, manifold pressure or degree of supercharging, the experiments indicated.

The effects on volumetric efficiency of variations in rpm, inlet pressure, exhaust pressure, inlet temperature, and jacket temperature were determined over a wide range in tests with a Ford V-8, 1940 engine at the Sloan Laboratory, Massachusetts Institute of Technology. A paper on that subject by John Markell, Jr., presented the results in the form of curves in which the volumetric efficiencies were plotted against the non-dimensional ratio s/c, where s is the average piston speed and c the speed of sound in the inlet air.

Engine Horsepower Meter

A horsepower meter for aircraft engines was described in a paper by J. C. Luttrell of the Air Transport Command, Army Air Forces, and W. A. Petrasek, American Air Lines. As shown by the circuit diagram reproduced herewith, the installation requires a small electrical multiplying unit in the engine nacelle, an additional wire in the cockpit and an a-c rectifier type of voltmeter for an indicator. The advantages claimed for it are an over-all accuracy of 3 percent in bhp indication, simplification of power control, and confirmation of takeoff horsepower. Besides it provides a continuous check on engine operation, indicating defects as leaky valves and faulty ignition, which result in a loss of engine power.



AC horsepower meter circuit

Joseph Stuart, III, of Aeroproducts Division, General Motors Corp., explained a tabular, trial-and-error method for evaluating the steady bending stresses in a rotating propeller blade. After the bending moment at the shank section of the blade has been estimated, the corresponding radial-bending-moment distribution is calculated by tabular integration. Additional trials with appropriately revised shank-section bending-moment estimates are then made, until the distribution is found which gives the required moment value of zero at the blade tip.

Case Hardening Steel with Radio Frequency Energy

The Industrial Electronics Division of the Federal Telephone & Radio Corp. announced the development of a process whereby the surface of steel parts can be hardened by using radio-frequency energy. This case-hardening method is said not to affect the physical properties in the steel beneath the surface, and not to cause distortion or scaling of the part, thus making it possible to finish-machine to final dimensions prior to heat treatment. It is applicable to flat surfaces as well as to internal and external cylindrical surfaces. Uniformly hardened cases 0.005 to 0.030 deep and controllable to within ± 0.001 have been produced in a half to one second. For most applications a frequency between 5 and 15 million cycles per second and a power between 25 and 75 KW is recommended. Due to the high temperature gradient between the surface and the interior, self-quenching of the surface was found to be adequate in many cases, it was reported by V. W. Sherman, company engineer.

Strengthening Metals

A method for design-strengthening sheet metal was described by Richard S. Smith, president of Rigid-Tex Corp., and Hamilton Gray, of New York University. This improvement is made by passing thin sheet metal through rolls bearing lozenge-shaped patterns, which distort the cross-sections of the sheets into wave-like or other shapes. Greater stiffness is imparted to the processed sheets by these patterns without increasing the unit weight or reducing buckling strength in any direction. In addition, the yield point and tensile strength are increased by the cold rolling.

A. U. Kutsay and A. J. Yorgiadis, research assistants at Pennsylvania State College, reported at the materials meeting that the cold working of solid magnesium-alloy rod decreased its damping capacity considerably.

During an investigation of elevated-temperature aging of 24S aluminum alloy at Lockheed Aircraft Corp., under the direction of Paul P. Mozeley, it was found that various combinations of time and temperature produce similar results, although the most satisfactory treatment for 24S alloy appears to be at 375 F for 8 hours. He stated that this treatment will raise the tension yield point some 40 to 60 per cent, and the ultimate tensile strength about 10 per cent, depending upon the amount of elastic strain in the material, while at the same time the elongation is reduced about 5 per cent in 2 in. In order to assure consistent physical properties after aging, it is necessary to control the degree of cold working during manufacture. Physical properties are slightly lower in compression than in tension.

New Instruments

R. Dixon Speas, research engineer of American Airlines, proposed two new systems of power control—

(*Turn to page* 42, *please*)

Airbriefs

By Henry Lowe Brownback

Criticism

Some of my readers have written to me protesting certain criticisms which have appeared in AIRBRIEFS. It is not the intent of this column to boost one technique at the expense of another. However it is generally wholesome for the writer of a column to criticise where it is believed that such criticism is constructive. Our friends the British are temperamentally far ahead of us in this respect. One of the worst features of our own present frame of mind is that we cannot consider anyone as a "middle of the road" advocate. If you curse Communism you are branded a Fascist or a Nazi and vice-versa.

Unfortunately some of the same intolerance has crept into our technical outlook to a much lesser extent and many of us have a tendency to look upon engineering as something static—something which has created the "ultimate." Science is not static and the laws, theories, and machines of today are bound to be changed and disproved as fast as man gains knowledge enough to take the next step forward. I'm not very ancient but I have seen so many "laws of nature" and so many "ultimate" designs pass into the discard that I can honestly advise any man who believes that anything in science is static to take up some other line of endeavor because some dreamer with the necessary scientific background to make his dream a reality will come along and turn his world upside-down.

Wood

Because of the scarcity of metal American aircraft builders are forced, reluctantly, to turn to many wooden parts for both fighter and training planes. These parts run a whole gamut of control surfaces, doors of various kinds, bomb bay doors, etc. The aircraft trade, the military services and most aviation technicians have been so well "sold" on aluminum alloy airplanes and propellers that anything else seems to them to be using something far inferior and even unreliable. On the other hand most of the European countries have always used considerable wood in their aviation matériel, often preferring it to metal and in spite of the fact that the richest bauxite source in the world is in the Rhone Valley in France.

True, with old fashioned techniques and unreliable glues, many wooden structures were unreliable, but with modern woodworking techniques and plastic fillers and adhesives there need be no fear of wooden aircraft structures and it is my belief that certain of these new materials are going to solve many of our problems. At the present time there is much uncertainty about wooden aircraft parts as some contracts to build them have been let to plants with no aircraft experience, no aircraft personnel and no background of scientific woodworking, but simply a background of doing fine woodwork.

The making of these improved wooden structures is just as much of a specialized business as the manufacture of heat treated metal structures and factories doing the work must be fully equipped to do it and have a scientifically trained personnel.

The tremendous "flash in the pan" glider program threatened to engulf the woodworking industry and many plants, rushed into readiness for the production of glider parts, are now looking for work. The use of wood in existing aircraft and the building of large wooden aerial freighters will take up much of this slack.

Humidification

The average woodworking plant must be air conditioned and humidified to make good aircraft parts. Gluing should be done at about 75 F. and the relative humidity should be 55 per cent. On the other hand any doping of cloth should be done at from 80-90 F. and at a very low relative humidity.

Laminated Wood

Laminated wooden structures are those made out of several thicknesses of wood or wood veneer with the grain running in the same direction. Laminated wood has usually been made in a cold press at relatively low pressure using cold glue. In modern aircraft this means urea resin glue. The setting time of the glue and the quality of the glue line can be improved by the use of a high frequency electric generator which is used to create heat directly in the wooden parts being glued together. A new and interesting laminated wood is made using many layers of thin veneer which has been impregnated with a synthetic resin, then coated with a phenol-formaldehyde adhesive and pressed together at about 3000 psi and heated by a hot plate press or by a high frequency generator. The result is a very dense wood cellulose plastic called "Compreg" which has many uses including propeller blades, The making and working of this material is a new and exact science and outside of the realm of ordinary woodworking.

Plywood

Plywood is laminated wood made with the grain of each ply running at right angles to that of the adjoining plies. Aircraft plywood is made with phenolic-formaldehyde resin adhesive applied either as a liquid in a glue spreader or as very thin tissuelike sheets laid between the wooden veneers. Plywood is made up and then charged into a hot plate press using about 150-200 psi pressure at 300 F. The heating also can be done by high frequency generator.

One of the important factors in the manufacture of plywood is the maintenance of an accurate degree of moisture in the veneer. Some of the machines used in the making of the sheets of veneer are remarkable. The giant lathes or other types of cutters which shave the boiling hot logs to paper-thin sheets and the tapeless splicers which take narrow sheets of veneer and glue the edges together to form large sheets are marvelous tools.

Formed Plywood

There are two general methods of making formed plywood—the Vidal and the Duramold. In the former the glue coated piles of veneer are placed over a male wooden mold, the whole cased in cellophane, then charged into a rubber bag from which the air is exhausted, thus "sucking" the bag tight to the mold then the whole is charged into a giant cooker or Autoclave into which steam is passed at fairly high pressure which exerts further pressure on the veneers on the mold and cures the glue.

In the Duramold process a female mold is used, usually made of metal, and the mold and glue coated veneers are covered with a rubber bag or a curtain which fastens to the base of the mold and covers the parts being molded and the whole is charged into an Autoclave. Many experiments are being made to make molded plywood parts with the high frequency generator and your columnist has made some very interesting experimental parts in this manner.

These new methods and new materials are completely changing the complexion of wood and making it into a reliable material from which complex parts can be made.

Fatigue of Metals as

By J. O. Almen

General Motors Research

Part Two

Part One appeared in the February 1, 1943, issue of AUTOMOTIVE and AVIATION INDUSTRIES.

PITTING of gear teeth is a form of fatigue that is induced by compression loads on the contacting tooth surfaces. The magnitude of the compression stress varies with the relative curvature of the contacting teeth in accordance with the Hertz formula; it varies with the degree of load concentration at the ends of the teeth, and with the applied load. The load that may be carried varies with the hardness and, therefore, with the strength of the material, with the temperature and with the manner in which the lubricant is applied.

Design factors that are effective in reducing the load concentration at the ends of the teeth also reduce the compressive stress. The relative curvature and, therefore, the compressive stress can be varied by the choice of pressure angle. In general, there is little to be gained by designing wide-face gears, except the doubtful satisfaction of dealing with smaller "stress numbers." In high-speed gears, pitting may occur when gears are transmitting no load. This is sometimes seen in the reverse idler gear of automobile transmissions. Although this form of transmission trouble is rare and occurs only when other conditions, such as hardness, are unfavorable, it serves to emphasize the part played by the lubricant in promoting fatigue. A reverse idler running submerged in oil will trap the oil between the gear teeth, and if the clearances are small, will induce extremely high surface pressures.

We are all familiar with the high temperatures that are generated in gear boxes when too generously supplied with oil, but we do not always interpret this as a fatigue hazard. High-speed gears should be lubricated by jets of low-viscosity oil directed at the teeth as they are coming out of mesh, not on the incoming side. This form of lubrication will wash away the heat of friction while it is still on the surfaces of the teeth, and will prevent excess oil from reaching the contacting teeth, providing the sump is dry.

There is evidence indicating that oil further contributes to pitting fatigue by entering surface fissures where, under hydrostatic pressure, the fissures are extended until pieces are lifted out of the surfaces of the teeth as described by Stewart Way.

When we try to quantitatively apply the accumulated laboratory fatigue data to such design problems, we find that they are almost useless. Published data on fatigue assume that (1) stress can be determined, (2) that laboratory test specimens are representative of a material when that material is formed into a machine part, (3) that the amount and nature of the applied load are known, (4) that load variations occur in an orderly and predictable manner, (5) that representative fatigue curves can be constructed from a dozen or less specimens, and (6) that machine parts must be stressed below the fatigue limit to be successful. These assumptions are not justified in practical design.

Stress Cannot Be Calculated

From the data on internal stresses that have been discussed, we may reasonably have some misgivings about the reliability of our stress calculations. From experience with practical machine parts we can only conclude that stress calculations by textbook methods are wholly inadequate until we generously temper our calculated results with experience. For example, crankshafts according to the usual methods of calculation may be stressed to 20,000 psi, connecting rods to 40,000 psi, valve springs to 90,000 psi, and disc-clutch springs 180,000 psi, while another form of disc spring supports, by calculation, 600,000 psi. Obviously, some of these stress values are ridiculous, but the formulas used in each case conform to the 'laws' of mechanics. The actual stress in crankshafts is probably several times 20,000 psi, while the 600,000 psi in the disc spring is not reached because of yielding in local highly stressed regions.

The unreliability of stress calculations has almost been forgotten by seasoned designers, because they no longer take the numerical values of their stress calculations literally. Instead, they have learned by experience that, by the usual methods of calculation, the numerical values have different meanings for different machine parts; that is, somewhat rough empirical correction factors are applied.

Extensometer Readings of Doubtful Value

There is a growing interest in various devices employed to make direct measurement of stress such as photo-elasticity, brittle lacquers, extensometers, and similar instrumentation, in the belief that these devices will provide accurate stress data. Stress data from such measurements usually are more accurate than those obtained from the most involved mathematical analysis, but that they are far from reliable can easily be shown by fatigue tests. Two specimens

S as influenced by design and internal stresses

of identical material, heat treatment and dimensions will show identical stress when measured by photo-elasticity or by extensometer, yet these specimens may vary widely in fatigue strength depending upon minute differences in surface finish or internal stresses. Since internal stresses are often desirable and are frequently unavoidable due to processing operations, such as machining, heat treating, straightening or grinding, and since surface finishes vary all the way from rough forgings to lapped or honed surfaces, there is little reason to expect accuracy from extensometer readings and even less for photo-elastic tests, since the specimens for this test must be free from internal stresses and must be made of another material.

Photo-elastic and extensometer readings are measures of elasticity in which the changes in dimensions are the statistical average of all of the material involved in the measurement. Fatigue tests provide a strength measure of the weakest portion of the material involved, usually at the surface, even though it be sub-microscopic in size. Obviously, we cannot expect agreement between fatigue measures of stress and the stress readings obtained from elastic measurements.

Even if stress could be determined, the fatigue data from laboratory speciment could not be used because machine parts cannot be finished with the care and exactness that is given laboratory specimens. Abrupt section changes cannot be avoided, high internal stresses are often present as a result of processing or because of local heating as from bearing friction, surfaces are subject to bruises and to corrosion of various kinds. These effects cannot be evaluated in terms of stress raisers in controlled laboratory specimens.

Fatigue Data Are Mortality Data

Fatigue data are mortality data, and it is just as absurd to expect that reliable actuarial tables can be constructed from mortality data on a half dozen individuals as to expect reliable comparisons from fatigue tests on a half dozen machine parts. When a sufficient number of machine parts are fatigue-tested at constant load and plotted in the manner of the well-known mortality curve for human life expectancy, we find remarkable similarity to human mortality experience.

Insufficient Test Data

Reliable life comparison of machine parts demands a large number of tests, unless the life difference is very great. It is obvious from the mortality charts that, on the basis of a few tests, the poorer design, material or process may rate higher than the better design, material or process. Yet nowhere in the literature do we find fatigue data approaching even the minimum requirements of reliability. The reason is largely that most of the investigators in this field, particularly in work on steel, assume that we have no interest in data at any stress except the stress at which the specimen will endure indefinitely.

In practical fatigue testing of machine parts, it should be obvious that comparisons of material, design or processing cannot be made unless the tests are run to failure and the comparisons are made on the number of stress cycles each will endure. This is true whether or not the part being tested is required to withstand, in service, a very large number of stress reversals at maximum load such as a crankshaft or a relatively small number of stress reversals at maximum load, such as chassis springs. Since all representative tests are made at loads that result in failure by fatigue, our interest lies not in the fatigue endurance limit where for steel, under most test conditions, life is infinite, but in that portion of the fatigue curve to the left of the "knee" where life is finite, that is, the sloping part of the curve.

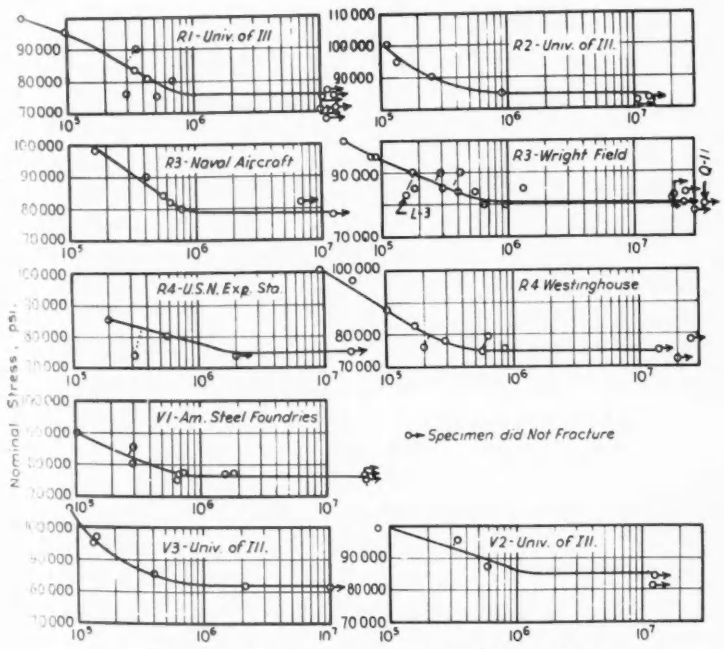


Fig. 7—A.S.T.M. cooperative fatigue tests. Semi-log plot

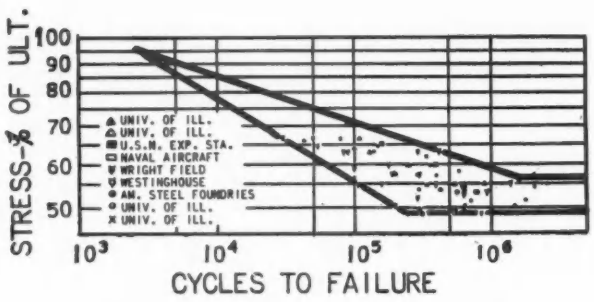


Fig. 8—Re-plot of published data

The characteristics of the sloping part of the fatigue curve have been obscured in most of the published S-N plots by (a) never having enough test points and (b) by the popular custom of plotting fatigue data on semi-log charts. In the very few cases where published data contain a considerable number of test points, we find that when plots are constructed on log-log charts the points tend to lie on a straight line instead of on a curved line as when they are plotted on semi-log charts.

The research committee of the A.S.T.M. recently sponsored a cooperative test program in which several laboratories conducted independent fatigue tests on identical material (heat treated SAE 4340) under similar test conditions. The results were reported in an A.S.T.M. research report from which the group of plots shown in Fig. 7 were taken. Note the wide disagreement between the curves from the several laboratories in the fatigue limit, as well as in the sloping part of the curves. When all of the 59 individual "Failed" points are plotted on a log-log chart, as is shown in Fig. 8, we begin to see a semblance of order in that all of the points lie within a scatter band of converging form.

It is possible that the average fatigue curves for two materials having different tensile strengths and yield points will cross at some point in the finite life region due to differences in sensitivity to stress raisers. In such cases, life comparisons may be positive for one material at one test load and negative for the same material at another test load. The diagram Fig. 9 illustrates such a situation.

It is evident, therefore, that true comparasions can be obtained only through fatigue tests on a sufficient number of parts at varying loads to outline the slopes of the scatter band limits. While this may appear to be an impractical requirement, it is not so difficult as it seems. It is only necessary that the results of the present routine tests be accumulated on a fatigue diagram and in a relatively short time fatigue curves and their scatter bands will be available for a large variety of machine parts.

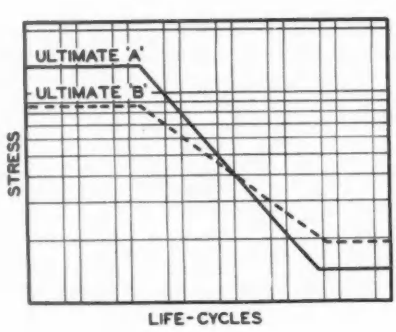


Fig. 9 — Fatigue curves for two materials having different strengths

Only occasionally are fatigue tests on machine parts run at various loads. In the very few cases where data from a reasonable number of such tests run at sufficiently large load differences are available on commercially identical parts—a reasonable number being one or two hundred—we find that the scatter of the test points when plotted on logarithmic co-ordinates falls within a well defined pattern. This pattern tends to radiate from a point at high stress and a low number of stress cycles and to diverge to a broad band at low stress and high number of stress cycles.

This is clearly shown in Fig. 10, which is a fatigue diagram of about 200 complete automobile and truck rear axles of various makes and sizes. The stress scale shown in this diagram is not actual stress but is believed to be proportional to actual stress. The axles were tested at loads to produce failure of one or more pinion teeth through the range of from 7,000 cycles to 1,000,000 cycles.

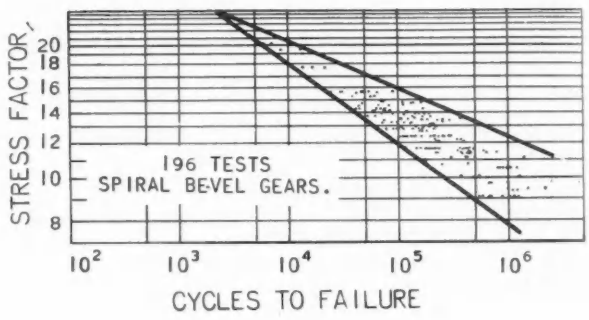


Fig. 10—Scatter band

The scatter of the test points is due to variations in one or more of the many variables that are always present in commercially-similar parts, such as internal stresses, fillet radii, cutter scratches, bearing, shaft and housing deflections, warpage in heat treatment, and so on.

We seek to determine actual stress only as a step in predicting the adequacy or inadequacy of our designs. Any other means that will enable us to predict the performance of our designs will do as well. Ball- and roller-bearing manufacturers do not consider stress at all in their catalog ratings, but rely entirely upon tabulated load capacities as determined by service experience that has been correlated with laboratory test data on complete bearings. In practice we not only are unable to calculate or to measure stress, but we do not even know the manner of load applications in service on the majority of machine parts.

Laboratory fatigue testing of automobile or other light-weight, high-output machine parts, as well as other laboratory tests such as on fuels, oils, tire wear, and so on, must be definitely correlated with service

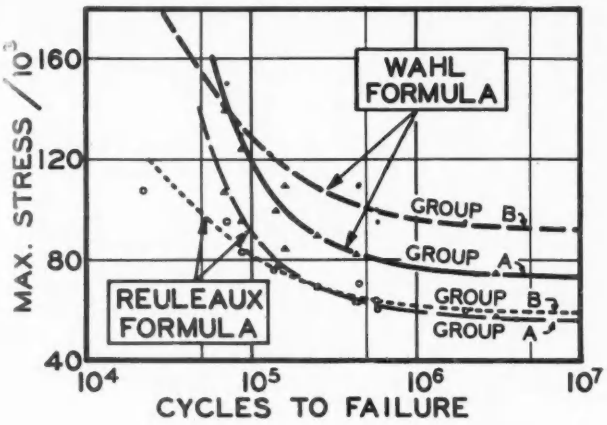


Fig. 11—Comparison of helical spring formulae by fatigue curves

data on the part in question before the results can be accepted. This requires that, for fatigue tests must be devised that will agree with failures that occur in normal service as to the location of points of fracture and the character of the fractures, whether or not the test procedures agree with preconceived notions of service loading.

Since we have no reliable means for determining stress, and since fatigue tests on laboratory specimens cannot be used for evaluating the strength of machine parts, we have no recourse but to continue fatigue tests on machine parts in our industrial laboratories. There is, however, much that we can do to improve our technique in setting up the conditions of tests and in interpreting the test data.

The methods now used for coordinating laboratory tests with service experience are too haphazard to be completely reliable. Service failures must, obviously, be infrequent and when true fatigue failure does occur, it is the result of harder-than-usual service combined with a specimen lying on the lower fringe of the fatigue scatter band.

Since failures must be infrequent, it is highly important that failed parts be examined by competent observers in order that the true cause of the trouble may be determined. Clear evidence of fatigue failure does not prove that the failed part was primarily responsible. A bolt may fatigue because it was not properly tightened during assembly; a gear may fatigue due to improper support or to a failed bearing; a crankshaft may fatigue due to an inadequate or a mal-adjusted vibration damper; and so on without end. It sometimes happens, therefore, that immediate corrections are made to the wrong part, and recognition of the true trouble is sometimes greatly delayed.

Laboratory fatigue tests on machine parts must not only duplicate service failure as to location of fracture, but they must, in some cases, produce failure in approximately the same number of stress cycles if accurate life comparisons are to be made. This requires that we distinguish between normal operation stress and the relatively infrequent overloads that caused the failure.

Rear-axle automobile gears are, at worse, stressed at low-gear torque one cycle out of every one thousand cycles. The lifetime requirements of such gears, therefore, is 100,000 cycles at low-gear torque equal to approximately 30 miles of travel. Owing to the scatter of test points, this is approximately 250,000 cycles measured on the average fatigue curve.

Chassis springs normally operate through a small stress range, but they must be designed to withstand a total of high stress cycles equal to the number of bumps that will be experienced by the hardest driver on the worst road. This is a relatively small number of stress cycles, but the problem is aggravated by the fact that such springs are subjected to severe corrosion and to surface damage by stones. Hence experience requires an average lifetime of 100,000 cycles at maximum amplitude.

Clutch springs in town driving are deflected approximately 500,000 times during the lifetime of an automobile, but not always at the maximum amplitude. Therefore, an average life of 500,000 cycles at full amplitude is a minimum requirement.

Fatigue data from machine parts can profitably be studied for the purpose of setting up empirical formulas by which load capacity eventually may be accurately calculated.

An interesting comparison of the relative accuracy of two formulas for calculating stress in coil springs was made by Edgerton. He plotted semi-log S-N curves for two groups of springs that were identical in every respect except that they differed in the ratio of spring diameter to wire diameter, the spring indexes being respectively 3 and 5. The stress for both groups of springs were calculated by the method of Reuleaux and

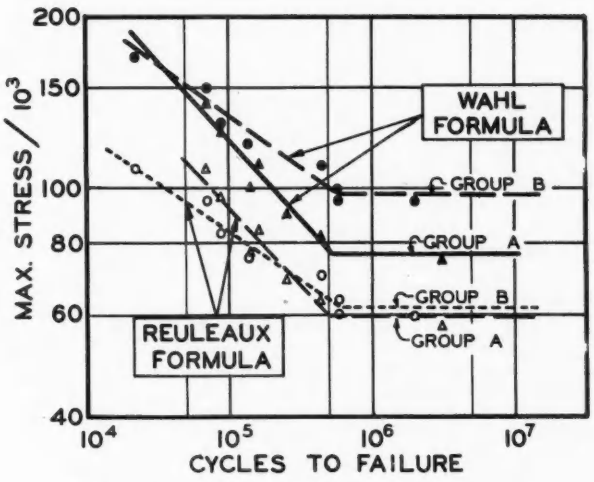


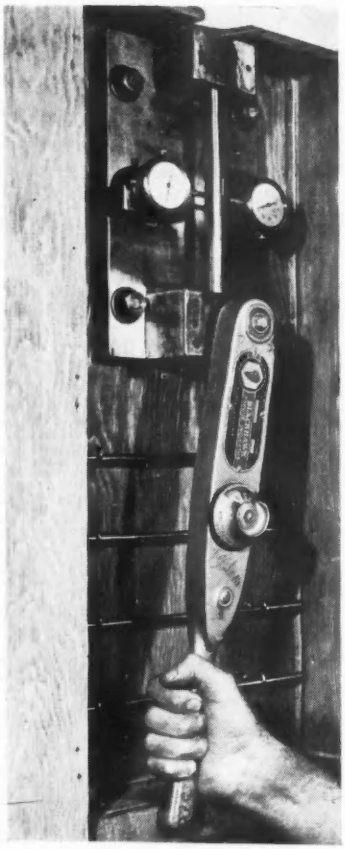
Fig. 12 — Comparison of helical spring formulae by log-log fatigue curves

by the Wahl method, with the results shown in Fig. 11. From this chart Edgerton concluded that the Reuleaux method was superior because the curves for both springs gave approximately the same endurance limit whereas the endurance limit for the two springs calculated by the Wahl method varied by 20 per cent.

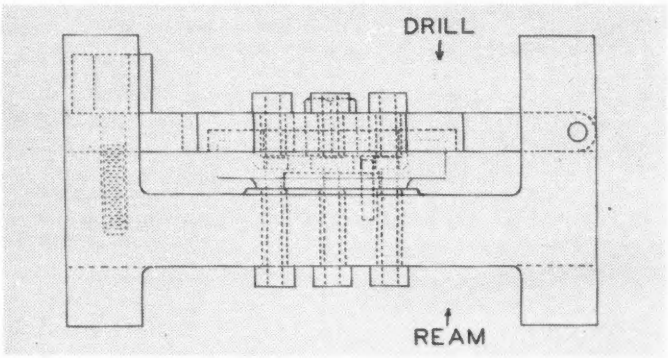
When these same data are plotted on logarithmic co-ordinates, as in Fig. 12, and analyzed by the hypothesis previously stated, we cannot escape the opposite conclusion. Note that the curves plotted to the

(*Turn to page* 88, *please*)

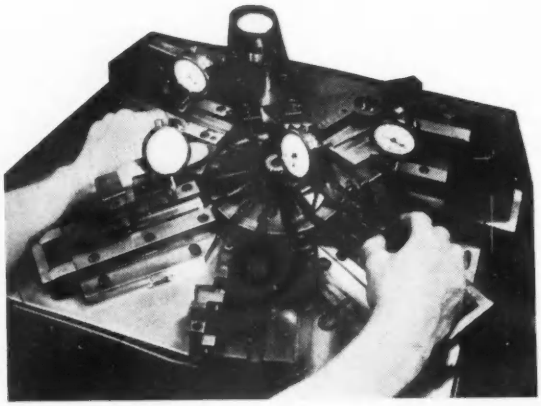
Short



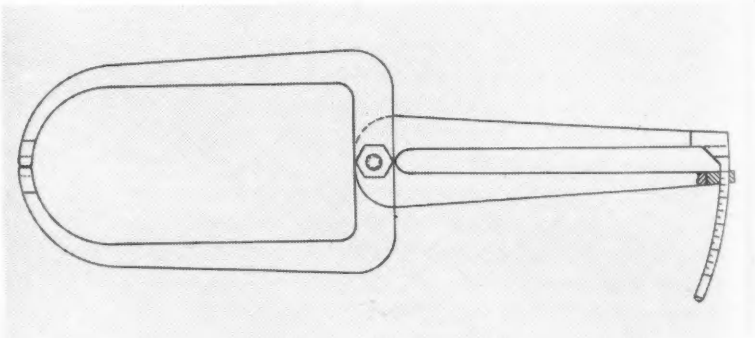
(Left) A big time-saver in the Vega inspection department is this deflection comparator for setting and adjusting torque wrenches.



(Above) For drilling and reaming an accessory-drive gear, a jig has been used in which bushings for drilling and reaming are alternated. The drill bushing is used to drill the several holes and is then replaced by the reamer bushing. Replacing of the bushings consumed considerable time, and Frank Roudebush of the Wright Aeronautical Corp. devised the jig illustrated herewith. Now there are six pressed-in bushings on one side, through which the holes are drilled, and six other bushings on the other side through which they are reamed. The jig is merely turned over between the drilling and reaming operations, and no bushings have to be removed.

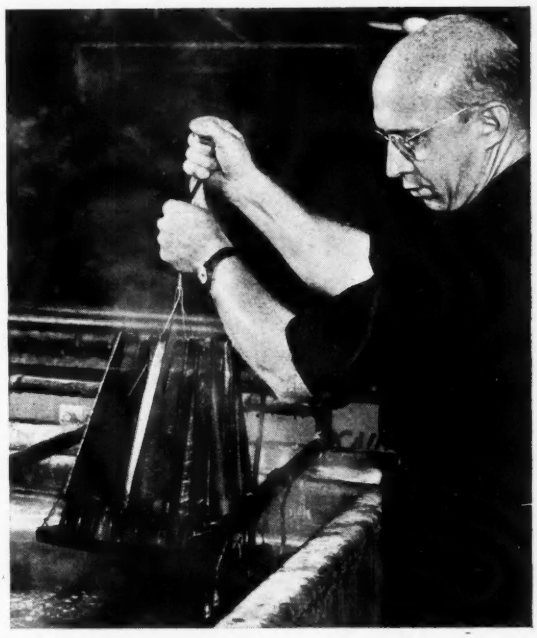


(Above) The impeller of the turbo-blower used on an aircraft engine formerly was machined from a solid steel blank, after which the 15 blades were twisted to the proper angle. This method required many different steps to ensure uniformity of product, and therefore was unsuited to quantity production. Cadillac designed a number of new machines for the production of this complex part. This cut down the man-hours per unit from 125 to 10, and resulted in a saving of 20.66 lb. of metal per engine. The accompanying photographic view shows a special gage that was designed to check 5 dimensions on each of the 15 blades. Nearly 220 inspections are necessary on each impeller before final acceptance.



(Above) A design of special calipers for measuring the wall thicknesses of castings has been submitted by Stanley Crawford of the RCA Manufarturing Co. With ordinary calipers such measurements cannot be made, because the calipers must be opened beyond the point of measurement to get them out of position. It is claimed that these calipers not only speed up the inspection operation but have made it possible to reclaim costly castings that had been rejected as faulty.

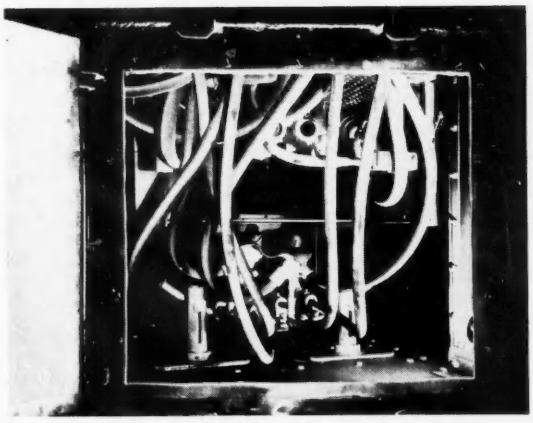
Cuts

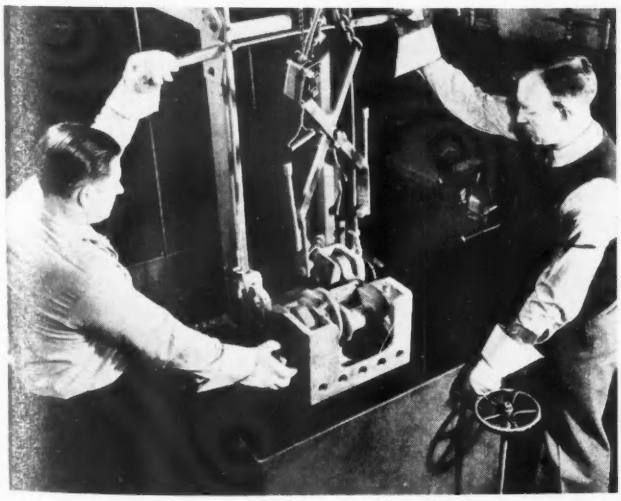


(Below) One man does the work of two with this portable pneumatic notching tool attachment, which was developed by V. K. Kennedy of the Douglas Aircraft Co. It is estimated that over 21 hours are saved per each C-54 transport in making cutouts in skins for flanges where stringers pass. The job can be done on a jig without removing sheet stock.

(Above) By developing an inexpensive cleaning and etching process, C. A. Terry has made it possible to recover about 95 per cent of the files that normally are thrown into the scrap metal boxes at the Northrop aircraft plant. Tests in the shop show that these reconditioned files give 75 to 100 per cent of a new file service. Used files totalling 450 that would cost about $160 when new were time checked at 4 hours for a complete processing. A brief outline of the process follows: 1. Degrease, Detrex machine using Blacosolv; 2. Electro clean in 12 per cent Anodex solution; 3. Hot water rinse; 4. Descaler, approx. 30 min. depending on condition of files; 5. Cold water rinse; 6. Etch in 15 per cent nitric acid solution, two min. maximum time; 7. Cold water rinse; 8. Chromic acid bath, 15 to 30 min., if copper was present in nitric acid bath. 1 lb. acid to 1 gal. water; 9. Dry thoroughly after hot water rinse by placing files in drying oven; 10. Dip in lacquer and dry, using 1 pt. lacquer to 10 pts. lacquer thinner.

(Below) To prevent distortion of the crankshafts of radial aircraft engines during heat treatment, these shafts formerly were strapped between two pieces of boiler plate, and wedged, the strapping preventing run-out and the wedging, run-in. Chevrolet designed a special fixture which receives the hot shaft directly from the furnace. This eliminates two operations — strapping and unstrapping — improves the product, saves 93 per cent of the time formerly required for the quenching operation, reduces reruns from 6 to 0.9 per cent, and scrap from 4.8 to 0.3 per cent.



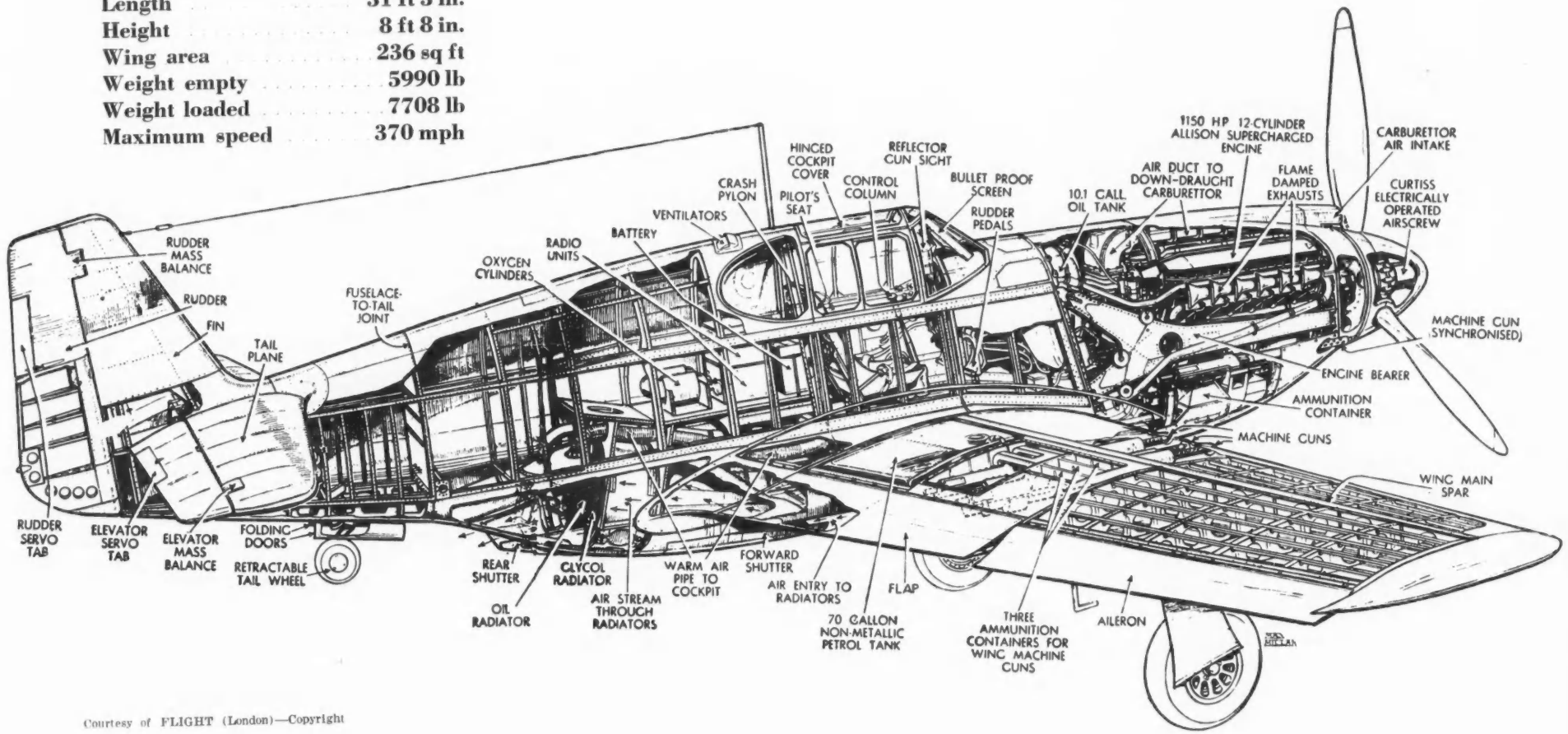


(Above) The burrs at the rocker-arm box in the cylinder head of a Pratt & Whitney aircraft engine generally are removed individually by means of an electric grinder, the time required being 20 minutes per cylinder head. Chevrolet now sandblasts the cylinder heads, which removes the smaller burrs, and the heaviest ones are then removed by electric grinder. The time per piece is reduced from 20 to 6 minutes, and it is claimed that the product is improved.

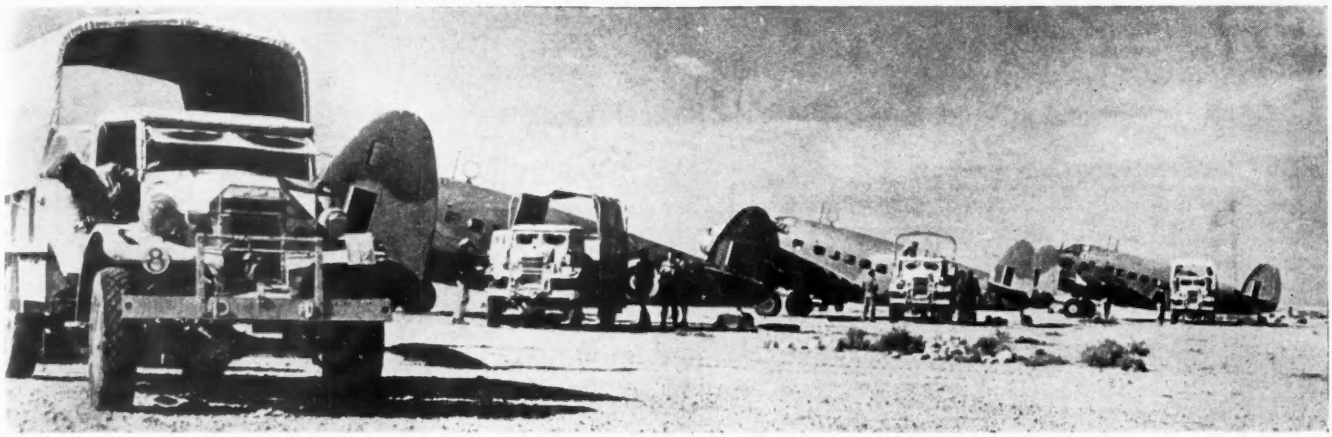
North American Mustang (P-51)

Specifications

Span	37 ft 3 in.
Length	31 ft 3 in.
Height	8 ft 8 in.
Wing area	236 sq ft
Weight empty	5990 lb
Weight loaded	7708 lb
Maximum speed	370 mph



Courtesy of FLIGHT (London)—Copyright



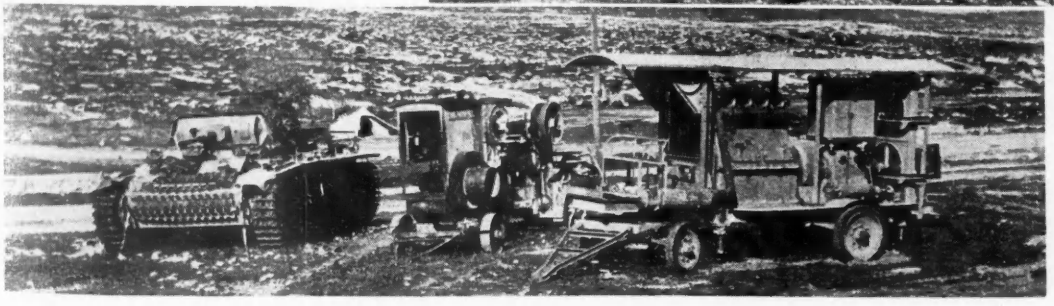
The Desert Front

British Combine Photos

(Top)
Transport aircraft have played an important part in the recent British offensive through Egypt and Libya, large quantities of military supplies being flown to advanced units which had outdistanced ground communications. This photo shows trucks backed up to Lockheed Hudsons at an appointed rendevous in the desert to take on ammunition that was flown there for armored units.

(Left)
The Germans left this mobile artillery unit—a 75-mm gun mounted on a tank chassis.

Among the booty captured by the British were this German Mark IV special tank transporter and tank.



Tank, air compressor for pneumatic drills and other road making equipment abandoned by the Germans in their flight.

(Right) "General Waste" is shown at a different gate each week to thousands of employes.

(Below) Some of the posters used at Vega to dramatize ways in which the production army can back up the fighting army—by conserving material.

THE Material Conservation Program at Vega Aircraft's plants in Burbank, Calif., has had some unique problems to solve, yet has met them with a remarkable degree of success. The value of this work can best be shown by the fact that over $1,400,000 has been saved in the last year.

Other plants now converting to war production are encountering the same basic problems in the waste of materials. Unprecedented expansion has necessitated the hiring of thousands of inexperienced workers, who have to be educated to conservation while on the job. The idea of "One-plane-this-year-is-worth-ten-planes-next-year" has forced the management of many plants to partially abandon slower, but more economical manufacturing methods. This creates a need for a group whose sole interest is to solve individual problems of material waste, as they arise.

Vega management recognized these two problems early in 1941 and appointed E. E. Eberth as Material Conservation Supervisor. At present he is working with W. A. Hall, and together they have expanded the division into four sections:

Vega's Material

Conservation

1. One section of men devotes all its time to material handling problems. They investigate and recommend equipment to protect fragile parts, such as plastic and glass windshields. They also see that racks, dollies, frames, and bins are used properly, and routed back ready for re-filling when needed.

2. The second section handles all reclamation problems. They strip usable parts from spoiled assemblies and see that these parts get back into the production stream. They prevent obsolete and rejected parts from being wasted.

3. The disposal section sees that scrap metal is properly segregated at its source. They have charge of the collection of scrap and its sale to dealers, in accordance with Government regulations.

This stand is inside the Vega main gate and is used by thousands of men and women before they leave the plant every day.

Important material is saved by welding together scrap butt ends of cast manganese bronze cored bar stock used in the making of landing gear shims.

Program is a Selling Job

By John A. Brash
Job Analyst, Lockheed Aircraft Corp.

supply posters and cartoons. Seventy-five poster locations have been set up in prominent places throughout the shop and each week they are rotated so that each employe will eventually see every poster, and each week new posters are introduced.

One phase of the educational program is the constant barrage of cartoons, articles, slogans, and photographs which appear in the two employe's publications, the weekly "Lockheed-Vega Star" and the monthly "Vega Aircaster."

Exhibits have been constructed to be shown throughout the plants. One example is "General Waste," a mechanical man, 8 ft high, built of spoiled parts. Each week, the "General" is shown at a different gate, where thousands of employes are being exposed to his propaganda.

An effective exhibit was constructed to show workers how wasteful the incorrect use of tools can be. It consists of a board, 4 by 6 ft, on which are shown twelve of the most commonly broken tools. Across the top of the board is printed, "Every Broken Tool is a

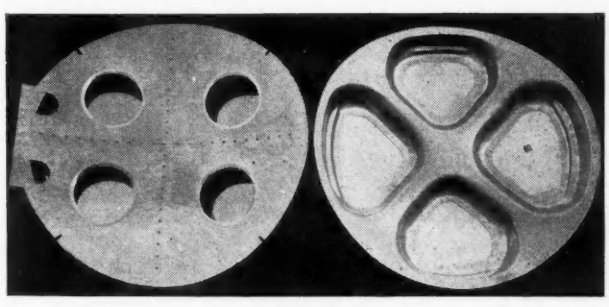
(*Turn to page* 84, *please*)

4. The material conservation section has a variety of functions which are discussed more fully.

The ideas developed can be applied to any industry, but are more striking in aircraft because the materials used are scarce, and constant design changes prevent rigid standardization as it is known in more stable industries.

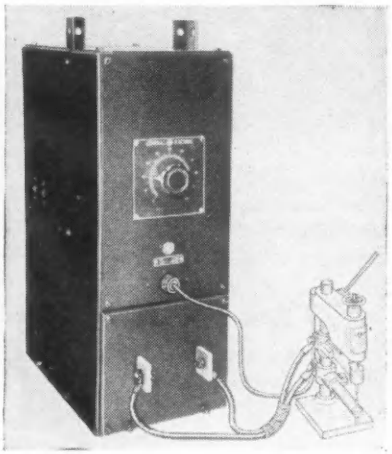
Education

The educational part of this work is to make every employe conscious of the necessity of saving all possible material for the war effort. This is done through many channels so that the story is continually being hammered home in a variety of interesting ways. The facilities of the art department have been used to



Two layers of sheet metal are used for the navigator's hatch shown at the left. A proposed redesign (right) will use less vital material.

New Production Equipment



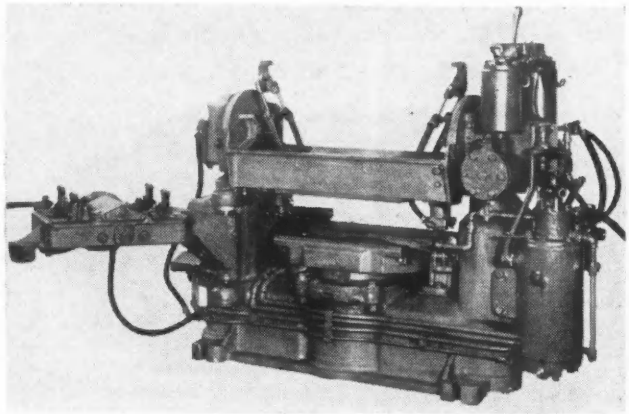
G-E Half-Cycle Electronic Spot-Welding Control Panel, CR7503-A136, with Bench Welder Connected

A SPECIAL machine for drilling, reaming and tapping holes in the flanges of crankshafts, has been designed by the LeMaire Tool & Mfg. Co., Dearborn, Mich. It is a compromise between a single spindle setup and one having fixed spindle drill heads in addition to individual fixtures, for various models of crankshafts to be machined, and was developed for manufacturers whose total volume of shafts produced might be made up of several different models. Three horizontal spindles, spaced 120 degrees apart around a circle, can be spaced to any bolt circle diameter from 5½ inches to 10 inches. By indexing the head in which these spindles are mounted, it is possible to drill flanges having 3, 6, or 12 holes. For drilling and reaming, the movement of the spindle head is hydraulically controlled; for tapping, the hydraulic cylinder is disconnected and the taps are fed into the work by manual operation of the star handles. A limit switch controls tap reversal when the slide has moved the required distance. A range of drilling and tapping speeds is provided by a four-speed transmission.

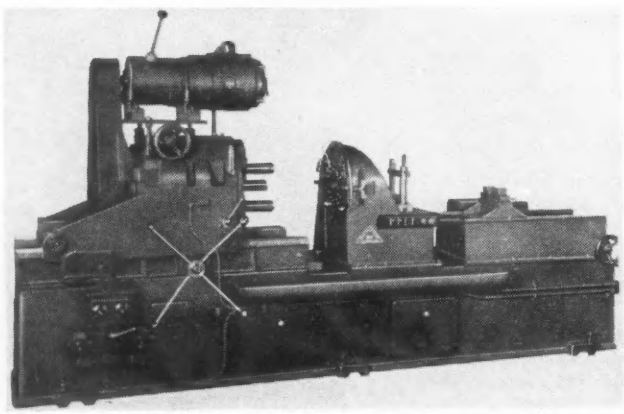
AN ELECTRONIC half-cycle synchronous control for the precise operation of resistance-welding machines has been announced by the General Electric Company, Schenectady, N. Y. The control is furnished in two types, the CR7503-A136, which also includes a welding transformer and is designed for bench mounting, and the CR7503-A133, which is without a transformer and is designed for wall mounting. Both types can be used either with tongs or with a suitable bench welder.

The control features the new GL-415 tube, a new circuit which makes higher speed welding possible, and a simplified initiating circuit which improves performance and reduces maintenance. The design also includes heat control by the phase-shift method. Heat adjustment is made by a dial mounted on the front of the cabinet.

THE Osborn Manufacturing Company, Cleveland, Ohio, has developed a moulding machine which features a power rollover mechanism built around a double acting hydraulic piston using air on oil as a source of power and providing an oil cushion at both ends of the stroke. The mould is rolled over with a smooth, positive motion with very little effort on the part of the operator. The use of power to roll over the machine table carrying a pattern and a half flask of sand is said to make possible the efficient operation of these machines by women workers in the foundry.



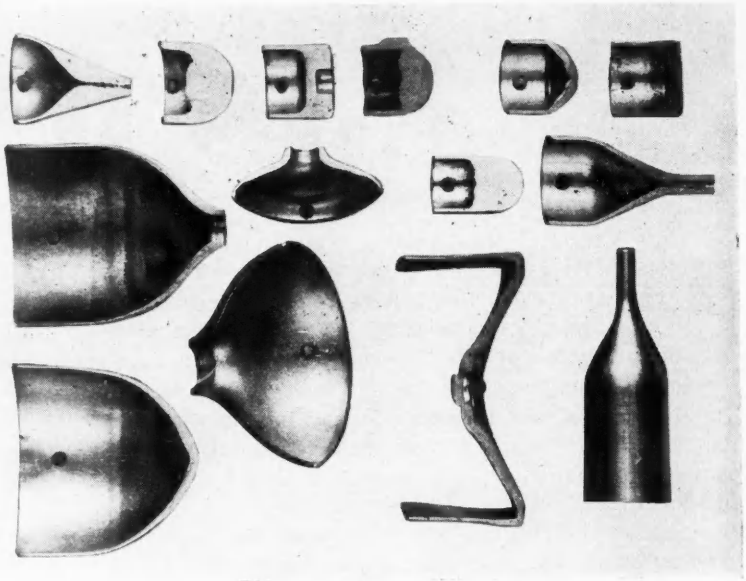
The Osborn Moulding Machine



Le Maire Crankshaft Machine

THE first of a series of standardized flash-welders is being introduced by the Progressive Welder Company, Detroit, Mich. This Model C flash welder, rated at 150 KVA, features a "Flashtrol" monitor which provides an automatic weld-quality control by eliminating short-circuiting of the flash-welding arc. This monitor unit is based on the application of an electronic device which

(*Turn to page 92, please*)



Some examples of the character of tube-spinning and necking operations developed by the new Wolverine "spun end process."

Wolverine

Spun End Process

THE Wolverine Tube Division of Calumet and Hecla Consolidated Copper Co., Detroit, has released details of its unique Spun End Process developed by Walter P. Hill. Essentially an application of the art of spinning tubular members along entirely new lines that promise a savings of major importance in critical materials and in man and machine-hours, it employs a specially designed spinning die into which the tubular member is fed. Usually, the die is rotated while the tube is held stationary and fed in either hydraulically or by hand. The operation can be performed on simple equipment such as a drill press or a lathe, or it can be tooled for automatic operation with magazine feed in specially designed machines.

Some idea of the range of application may be gained from the fact that the process has been employed for closing the end of primer tubes, eliminating threaded plug assembly; for spinning over the end of cartridge cases made directly from tubing; for special necking operations; for reducing the diameter of tubing by drawing down to any desired smaller diameter; for making cylindrical parts with both ends closed or necked down. Seemingly there is no limit to the variety of forms that can be produced from tubing, eliminating special machining operations, welding, soldering, drawing, etc. The value of the new technique is further enhanced by the fact that it can be applied to tubing made of brass, copper aluminum alloys, Dowmetal, and even steel. Too, it appears to be applicable to a wide range of tube diameters. The process will handle steel tubing either of seamless or welded type without annealing and will produce a normalized and refined grain structure in the sun area.

The chief feature of the spinning die is a trepanned window opening in the die which permits the metal to expand during formation, relieving the pressure area and permitting the dissipation of heat. Both the shape and area of the trepanned window are directly related to the diameter and wall thickness of the tubing and to the material from which the tubing is made. These relationships are empirical and are determined experimentally. During the spinning operation, the metal attains a fairly high temperature and this temperature gradient is controllable so as to provide the proper range for annealing. For example, on brass tubing the temperature runs between 1200 to 1300 F, thus producing a finely refined structure superior to the grain structure of the parent tube metal. Because of the resultant ductility the process tolerates metal of any degree of hardness and eliminates the need for annealing operations either before or after the spinning operation.

Another valuable feature of the process is that it can be so applied as to produce a "gathering" or forging effect, providing any desired thickness of section in the spun area. This is effected simply by feeding the tube, under pressure, into the die until sufficient metal is available for the increased section thickness. In special cases where it is desirable to have close control of OD or ID in necking operations, the process can produce tolerances of any desired range with the introduction of suitable mandrels.

From the production standpoint, apart from making available a simple means for producing otherwise difficult formations in tubing, other important advantages are claimed for the process. For one thing die cost is said to be extremely low and almost negligible for mass-production runs. Moreover, the operation is so fast—from one to two seconds for most jobs—as to promise a great reduction in fabrication cost.

Due to the urgency of the war effort, Wolverine has made arrangements to make the Spun End Process available on a license basis and also has undertaken a comprehensive experimental program designed to explore other possibilities.

VDM Propeller

THE BMW 801A engine, described in AUTOMOTIVE and AVIATION INDUSTRIES of Oct. 15 and Nov. 1, is equipped with the VDM pitch-changing mechanism for the propeller. This is an interesting development, inasmuch as it comprises two separate devices, one for regular use, the other for use in bench tests, in emergencies when the power source of the first mechanism fails, and to stop an engine that has become disabled in flight, by "feathering" its propeller. The mechanism for regular use is hydraulically operated and automatically controlled, while that for emergency use is electrically operated and hand-controlled.

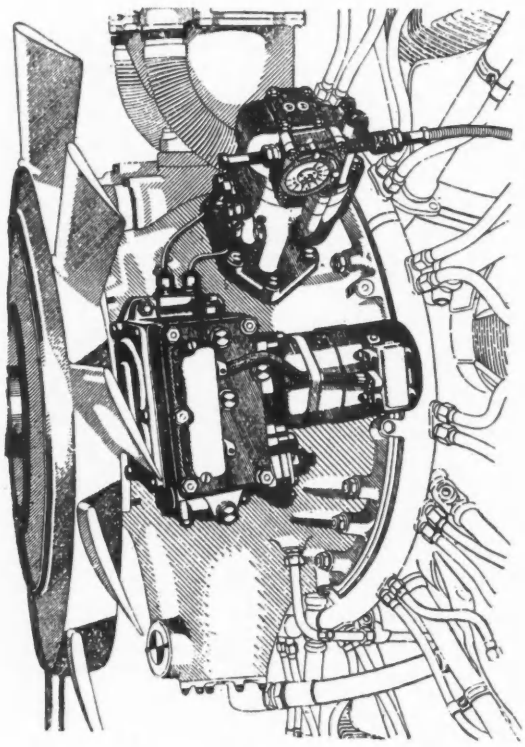
The pitch-changing mechanism includes a speed governor, which is mounted on the gear housing and is driven through a train of gears from the propeller drive gears; and the electric-hydraulic pitch-changing control by which power from the stationary pitch-control mechanism is transmitted to the pitch-changing gear acting on the blades and rotating in the propeller hub with the propeller.

The speed governor so controls the hydraulic pitch-regulating mechanism as to maintain any speed for which the control is set, under varying conditions of flight. It consists of a spring-loaded centrifugal governor acting on a relay piston. The spring tension of the governor is regulated by the control gear through a cable control to an amount corresponding to the selected boost pressure. The spring acts on one side of the relay piston and the governor on the other side. By this means, as the spring pressure varies, the oil under pressure is admitted to one side or the other of the hydraulic relay, causing its piston to rotate in one direction or the other, and changing the pitch of the propeller blades correspondingly. The pitch-changing motion continues until the spring force and the governor force are balanced, when the relay piston returns to mid-position and the oil inlet and outlet of the relay are closed again.

As the conditions of flight change, the propeller speed varies, and this affects the force exerted by the centrifugal governor. The relay piston is then forced out of its central position and the regulating process is repeated in the same order, until equilibrium is restored again and the engine returns to the speed for which the control is set.

The governor incorporates a gear pump which receives oil from the engine pressure lubricating system and boosts its pressure to that required for the operation of the pitch-control relay.

The electro-hydraulic pitch-control mechanism is shown in outside view in Fig. 1 and in diagram in Fig. 2. Drive from either of the two motors to the control gears enclosed in the gear housing is through a planetary assembly and a train of gears, the planetary assembly comprising the usual sun pinion, ring gear, and planet carrier. When the hydraulic mechanism is in operation, a ratchet fitted on the electrical side of the planetary assembly locks the sun pinion of the latter, and the hydraulic motor then drives through the planet carrier, thereby transmitting motion to the ring gear, which carries both internal and external teeth. If, on the other hand, the pitch is being adjusted by means of the electric motor, the planet carrier is locked by means of a ratchet on the hydraulic motor side; the electric motor then drives through the sun pinion, and the planet pinions, now stationary in space, transmit the motion to the ring gear, which latter connects through a train of gears to the mechanism in the gear housing. This description of the drive for the pitch-changing mechanism, which corresponds to that given in *Flugsport*, is not in complete agreement with Fig. 2, which was prepared from the powerplant of the plane shot down in England.



Aircraft Engineering

Fig. 1—Propeller-pitch control mechanism as installed on outside of gear housing.

The two extreme positions of the propeller blade, "Take-off" and "Feathered," respectively, are determined by a built-in, electro-hydraulic limit switch, which prevents the blades from passing beyond these limiting positions. The effect is obtained by means of two control valves operated by cams driven off the differential gear, which admit oil under pressure to

Pitch Changing Mechanism

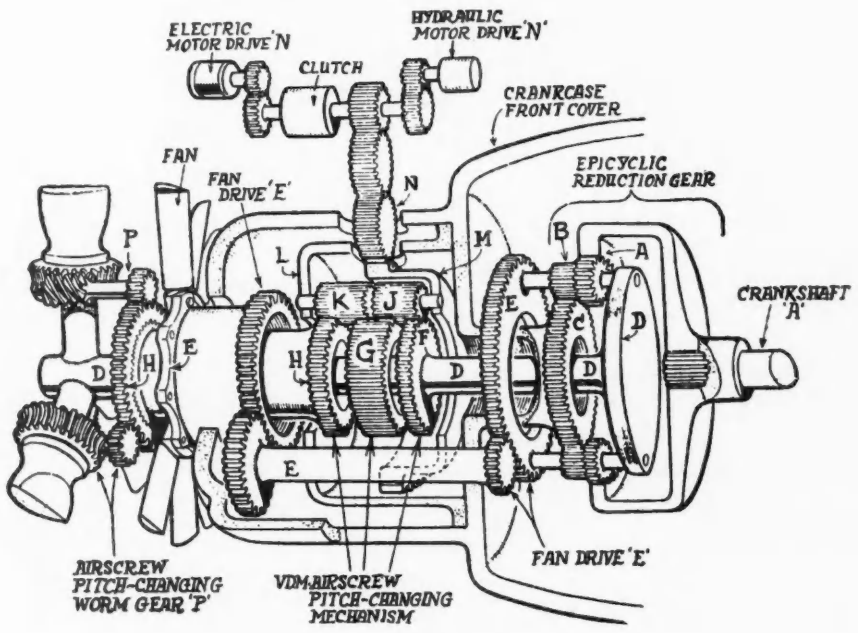
the cylinder of a piston stop valve in front of the relay.

Included in the pitch-control mechanism is an electro-magnetically operated hydraulic cutout which automatically cuts out the hydraulic mechanism when the circuit of the electric motor is closed, and vice-versa. The blade adjustment is indiated by a VDM pitch indicator, which is driven from the pitch-control mechanism.

While hydraulic adjustment of propeller pitch and the variation of the pitch to maintain constant engine speed are effected automatically, the electric pitch-changing mechanism is hand-controlled. For this purpose a rotary switch is mounted in the pilot's cockpit, on which there are the following markings: "Off," "RPM Increase" and "RPM Decrease." There is also a position for feathering, but this is not specially marked. This switch is used to adjust the pitch for take-off before the engine is started, and also, in the event of failure of the hydraulic control, to keep the engine running at constant speed for the particular inlet manifold pressure used.

Referring now to the diagrammatic drawing of the gear assembly, the pitch-changing mechanism comprises two planetary assemblies mounted side by side forward of the propeller reduction gear. Planet carrier *M* of one of these assemblies is rotatable within planet carrier *L* of the other assembly, *L* being bolted to the gear housing. Sun gear *F* is secured to the propeller shaft and meshes with planet pinion *J*, which latter is in mesh also with gear *G*, which is mounted loose on the propeller shaft. The planet pinion *K* of the second planetary assembly meshes with the free gear *G* and sun gear *H* at the rear end of the pitch control sleeve. Sun gears *F* and *H* both have the same numbers of teeth (70) and planet pinions *J* and *K* also have equal numbers of teeth, but the free gear *G*, while of the same outside diameter as *F* and *H*, has 73 teeth as compared with their 70. The rotatable planet carrier *M* is provided with a ring gear and can be turned around its axis, for the purpose of pitch adjustment, by either the electric or the hydraulic motor, both driving through a train of gears.

With the pitch-control mechanism at rest and the engine running, the drive is from *F* through *J* to *G* and from *G* through *K* to the pitch-adjusting gear *H*, and as both *F* and *H* have the same number of teeth, the pitch-adjusting gear *H* turns at the same speed as the propeller shaft, and no change in the pitch occurs. If now planet carrier *M* is turned around its axis through either the electric or the hydraulic motor, planet pinion *J* will roll on sun gear *F*, and because of the different numbers of teeth in *F* and *G*, will cause *G* to rotate with relation to *F* and to propeller shaft *D*.



The Aeroplane

Fig. 2—Diagrammatic view of pitch-control gear.

This motion of free gear *G* is transmitted through pinion *K* to pitch-adjusting gear *H*, which will thus turn relative to the propeller shaft and cause the angle of the propeller blades to be changed.

All of the governing and control elements are conveniently mounted on a central engine-control stand. They include controls for presetting and automatically maintaining the inlet-manifold pressure, the engine rpm, the mixture composition, the ignition timing, and the blower speed, all combined in a single instrument with a single control lever or handle. Besides relieving the pilot, this automatic control device is claimed to ensure optimum adjustment of the engine factors for both reliability in service and economical operation. This control instrument, which functions hydraulically, is included in a separate hydraulic circuit filled with a thin, frost-proof oil. Also included in this hydraulic circuit is a combined pressure and scavenging pump driven from the engine.

Aeronautical Engineers Study Developments

(*Continued from page* 26)

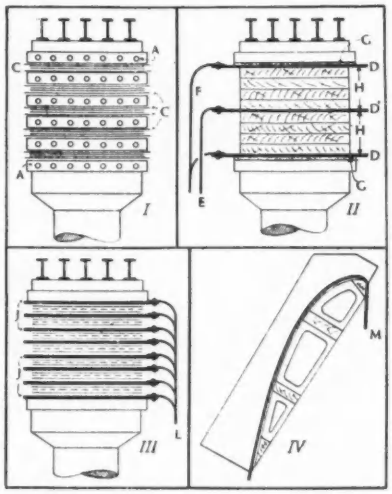
one for military cargo operation designated as "maximum payload miles per hour," the other for commercial cargo operation and called "maximum payload miles per dollar." He also described a new altitude-selection instrument named the Flight Plan Analyzer-Altitude Selector, which provides the following basic information to airline pilots for each potential cruising altitude: total time and fuel consumed, time required for each leg of flight, and magnetic headings for each leg of flight.

Other new developments presented at the meeting included an altimeter-setting indicator designed in the Instrument Division of the Weather Bureau; a new type of electrical control system suitable for radio control of vehicles or equipment and for electrical operation by wire of various mechanisms, which was developed at the Fairchild Aviation Corp.; a multiple recording manometer developed by United Aircraft Corp. for automatically recording the small pressures encountered in wind tunnel testing and consisting of a number of pressure-sensitive elements located within the model, the pressure readings at many different points being transmitted electrically to the observation room where they are recorded simultaneously on a chart; the Magnesyn remote-reading compass, developed by the Pioneer Instrument Division of Bendix Aviation Corp., which is not affected by the local magnetic disturbances in an airplane; and the Vultee radio recorder. This apparatus, described in the Jan. 15 issue of AUTOMOTIVE AND AVIATION INDUSTRIES, automatically transmits flight-test data from the plane to a ground station where they are decoded and recorded on charts by the receiving instruments.

Plywood Improvements

At the aircraft-production session Thomas D. Perry, development engineer of The Resinous Products & Chemical Co., reviewed improvements in plywood manufacture during the past two years. One of the outstanding developments has been a marked improvement in resin adhesives. In addition, a number of new types and techniques have been made available, including special resins for the flexible-bag molding processes. A wider range of catalysts now makes it possible to bond in one hour with urea-formaldehyde cold-setting resins without the use of hot presses, or with heat, in a few minutes. Phenol-formaldehyde resins meet the three-hour boil test of the Army-Navy-CAA specifications by a wide margin, and are available not only in film form, but also in dry-powder and solution form.

In the plywood field the application of pressure by gravity, springs, screw clamps, pistons and flexible bags is being further developed. Electrical methods of applying heat to cure the resins also are being studied, both resistance coils and radio frequency energy (see illustration) being used. The latter affords the only known method for the cure of phenolic resin adhesives in deep joints, as in a laminated spar, Mr. Perry stated. He also pointed out that properly-designed scarf joints make it possible to splice plywood into sheets as large as can be handled, and that such joints may have 80 per cent and over of the original strength of the normal unspliced sheet. Another means of extending plywood is the newly-developed continuous veneer splicer that glues together narrow strips. The latest advances in the manufacture of high-density wood by the impregnation of veneers with phenolic resins and the progress in "paper plastics" also were discussed by Mr. Perry. It was pointed out that the paper-plastic product has possibilities in aircraft construction, since a tensile strength of 30,000 to 50,000 psi can be obtained, and the process of manufacture is relatively simple.



Methods of heat applications for curing plywood resin adhesive bonds.

(I) Conventional hot platen press.
(A) Steam-heated platens.
(C) Aluminum cauls.

(II) Wood assemblies, heated between high-frequency electrodes.
(D, D') Electrodes, establishing electrostatic fields, H.
(E, F) Wire connections from transformer to fields, H.
(G) Insulating pads.
(H) High-frequency fields, containing wood assemblies.

(III) Conventional plywood press, without hot platens.
(J) Electrical resistance plates, used as cauls.
(L) Standard electrical connections.

(IV) Pressure jig for assembly work.
(M) Strip heater, to cure resin adhesive between skin covering and rib.

Other aircraft-production subjects included the plastic working of magnesium-alloy sheet, perspective illustrations for supplementing and in many cases replacing conventional engineering drawings, the photoprint process of reproduction in aircraft lofting, and graphic management control.

Design Problems Analyzed

Various problems affecting the design of airplane structures were discussed by engineers. D. S. Wolford, of the American Rolling Mill Co., emphasized the significance of the secant and tangent moduli of elasticity in structural design. Structures of light-gage, high-strength materials, to be effective, must be worked at stress levels exceeding the proportional limits, he said.

Two different but interdependent ideas concerning aircraft stress-analysis calculations were presented by Richard K. Koegler and Arthur Schnitt, Curtiss-Wright engineers, who analyzed the effects of bolt and rivet holes on the stress-strain curves and ultimate stress in sheet and extruded sections of 24ST aluminum-alloy material. It also was shown that the effects of yielding disclosed by the stress-strain curves are appreciable upon stress distribution and ultimate strength, and are worth taking into account.

Clarence Holleman, of Boeing Aircraft Co., gave data to establish the effect of holes on the tension efficiency of 24ST aluminum-alloy sheet, and values were proposed for use in riveted-joint design. Tests showed that the assumption of no loss in the tensile strength of material owing to stress concentrations at holes is not warranted in the case of aluminum alloys such as 17ST and 24ST, but appears to be valid for a ductile material such as annealed X-4130 steel.

Henry L. Langhaar, of the Consolidated Aircraft Corp., developed sets of curves determining the buckling stresses for 24ST aluminum-alloy columns and plates. Paul H. Denke, Douglas engineer, made a strain-energy analysis of incomplete-tension-field web-stiffener combinations. A new stress method for use throughout the elastic and plastic range of bending was developed in the paper of Frank P. Cozzone, Lockheed engineer.

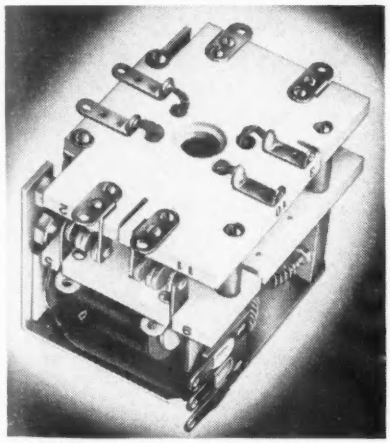
An extensive study of vibrations emanating from the power plant, flutter and dynamic loads was presented by William B. Bergen, of The Glenn L. Martin Co. The development of electrical vibration recording equipment, especially designed to meet the rigid requirements of aircraft flutter testing, was described in the light of tests first conducted in 1937 on an early Martin Clipper and continued on other models, including the Navy flying boat Mars. Measurements made to determine dy-

(*Turn to page* 78, *please*)

New Products for Aircraft

High Speed Keying and Break-In Relay

The Model AK relay, made by the Allied Control Company, New York, N. Y., is a high speed keying and break-in relay for aircraft radio equipment. It is designed for high voltage, high speed and resistance to vibration. Its push-pull magnetic arrangement provides magnetic holding pressure on both transmit and receive contacts. One pole is equipped with two windings, one of which is a holding winding connected directly across the battery supply. The other winding is connected in series with the single winding on the other pole and polarized so that

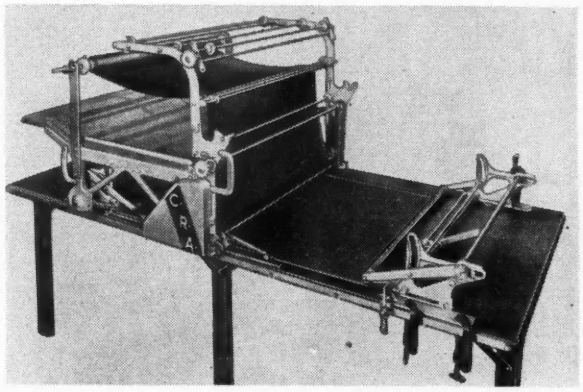


Allied Control Company's Model AK Relay

when the circuit is completed through the key, the flux is neutralized on the holding or receive position pole and the armature pulls up to the transmit position. Opening the key cuts off the bucking flux and the holding flux pulls the armature back to receive position.

Automatic Cloth Spreading Machine

The CRA automatic cloth spreading machine is for use in industries where fabric is laid out or spread in preparation for cutting. Its makers, the Cutting Room Appliances Corp., New York, N. Y., say that it will handle the lightest as well as the heaviest materials, on flat fold or rolls. Cloth guides keep the cutting edges straight, and automatic blade raisers, which control the goods, are adjustable to varying thicknesses. There is no cutting on the ends of the fabric. As the machine comes to the end of the table, or the end of the lay, automatic cloth catchers grip the cloth firmly along its entire width, and fold it over in the same action, thus facing it. Each ply is placed exactly on top of the one below so that the end of the bottom layer is even with the end of the top.



CRA Automatic Cloth Spreading Machine

Milling Machine for Non-Ferrous Materials

A new type milling machine, designed especially for machining non-ferrous material in sizes too large for handling by conventional milling machines, is being built by the Onsrud Machine Works, Inc., Chicago, Ill. Known as the A80-A Automatic Contour Milling Machine, this equipment employs four cutter heads, which, together with the controls, are mounted on the carriage. There are two horizontal and two vertical cutters which make it possible to perform up to four separate cutting operations on a piece of material in one pass of the carriage. One of the vertical cutter heads has a guide mechanism which varies the cutting angle while the carriage is in motion. Proper sequence and degree of tilt are automatically controlled by a template. Varying angle or twist cuts may be machined with this cutter. The second vertical cutter head can be tilted in a fixed position as much as 15 deg to the front or rear of the machine. Both horizontal cutter arbors are fixed in a horizontal plane and can be raised or lowered within certain limits.

The cutter travel is guided by means of templates which are made to the

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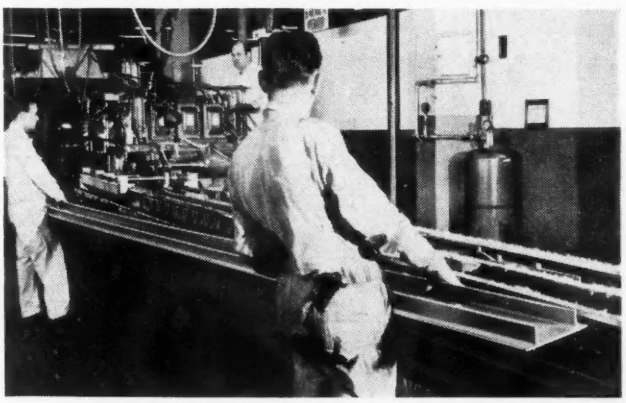


The Onsrud A80-A Automatic Contour Milling Machine

Martin Engineers Develop

New Apparatus f

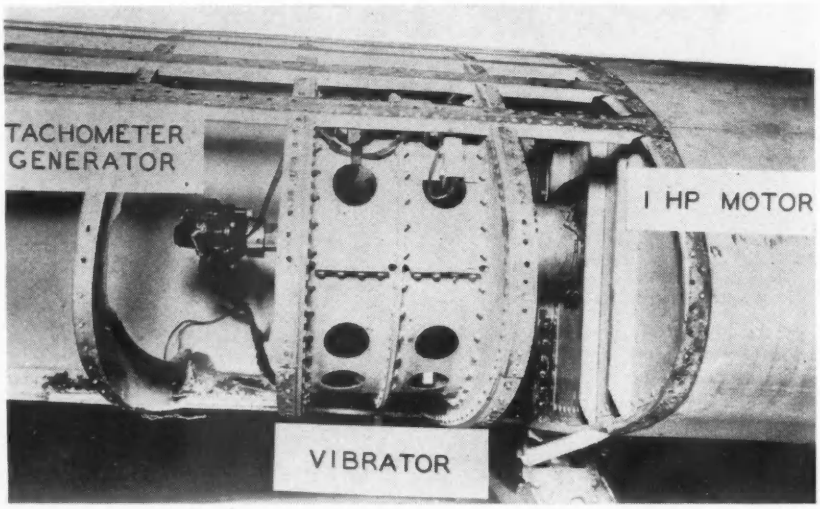


Fig. 1—Installation of vibrator and tachometer generator in front spar of wing.

ELABORATE equipment for studying problems connected with flutter of airplane wings and control surfaces has been developed by the Glenn L. Martin Company. Flutter consists essentially of resonant vibration of plane elements excited by aerodynamic forces. It seems that at certain critical air speeds these exciting forces have periods equal to the natural periods of vibration of the fluttering member; flutter then attains its maximum amplitude, and the stresses induced by the vibration may be sufficiently severe to cause the part to fail and the plane to crash.

Since flutter is a vibration phenomenon, the chief factors which can be determined by measurement are the amplitude and the frequency. Each vibration cycle, of course, consists of successive periods of acceleration and deceleration, and instead of measuring the amplitude, it suffices to record the accelerations and decelerations, from which, in connection with the frequency, the amplitude can be determined. Thus what is required is a pick-up device which is essentially an accelerometer.

In the earliest flutter tests the member tested was excited by gusts of wind; in later tests a known initial static displacement was imparted to the surface by a mechanical device, after which it was released and its transient motion was recorded. At

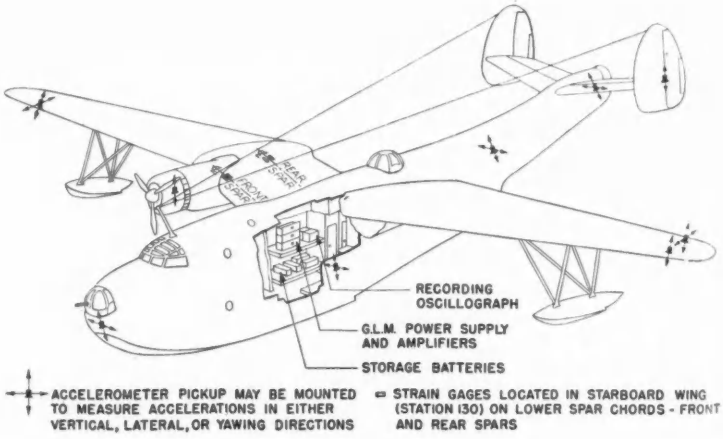
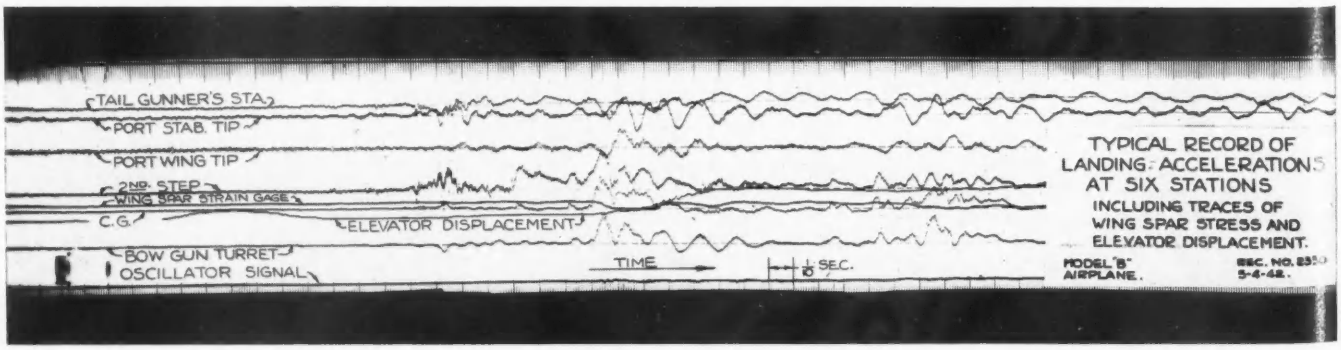


Fig. 2—Acceleration pickups and strain gages installed in flying boat.

Fig. 3—Typical record of landing accelerations at six points.



s *for* Vibration Studies

present a mechanical vibrator is used in all flutter tests. This consists of two opposed unbalanced weights on a shaft driven by a 1-hp d-c motor. The unbalanced moment of the vibrator is adjustable, but in tests on the Martin "Mars" flying boat a constant unbalanced moment of 40 lb-in. was used throughout. An electric tachometer is connected to the vibrator and constantly indicates the frequency of the latter. To permit of close speed control of the vibrator, a motor generator is included in the motor circuit. Vibration pick-ups of the induction type, weighing 2 oz. each, are mounted along the front and rear spars of both wings. The installation of the mechanical vibrator and the tachometer generator in the leading edge of the wing is shown in Fig. 1.

In making a test, the speed of the vibrator is varied between zero and 1100 rpm, while the plane is being flown at a constant speed, and the responses of the different pickups are recorded by a multiple-circuit oscillograph. The flying speed is raised by uniform steps up to 75 per cent of the designed diving speed, and similar records are made at each speed. At the same time the amplitude of the wing flutter is being observed visually. The resonance speeds of the vibrator are clearly shown by the records thus obtained. Actual deflection shapes corresponding to the various modes of vibration can be obtained by cross-plotting the records from the various pickups.

When the size of airplanes is increased, new difficulties are continually being encountered. For instance, under certain landing conditions a fuselage may vibrate or whip at one or more of its natural frequencies, and this whipping may build up stresses considerably in excess of the anticipated static stresses. On the other hand, certain load factors have a tendency to decrease with increase in size, and unless this is taken

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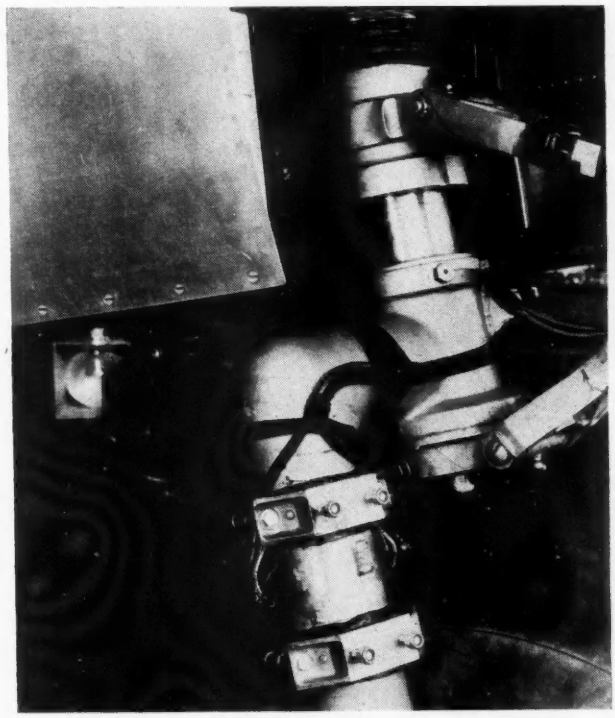
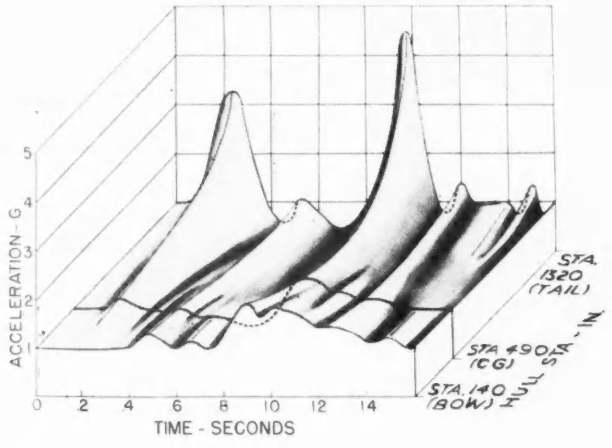


Fig. 5—Installation of strain gages on nose-wheel strut of a bomber.



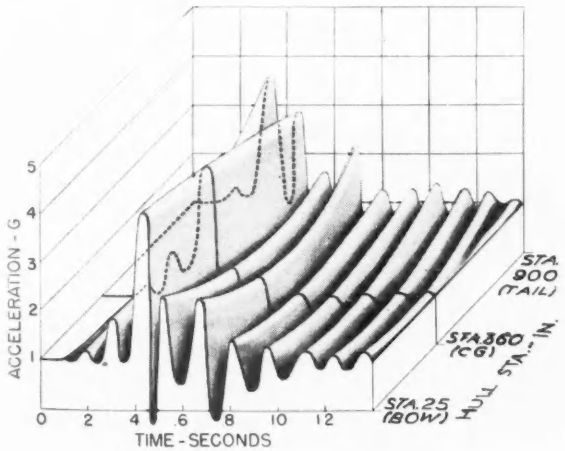


Fig. 4—Landing acceleration curves for two airplanes (Model A above and Model B below).

New Products

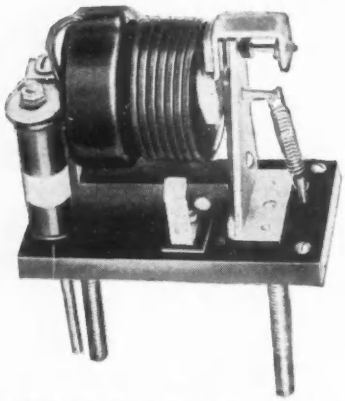
New Manganese Alloy

A new manganese base alloy is being introduced by the W. M. Chace Co., Detroit, Mich., as Chace Manganese Alloy No. 772. The composition is unique in that over 70 per cent of the alloy is manganese. This high manganese content and the resulting physical properties are made possible by the use of electrolytic manganese of a purity higher than 99.9 per cent. The alloy is said to have high electrical resistivity, a high thermal expansion rate, a high vibration damping constant, and low thermal conductivity combined with good ductility and high tensile strength. The electrical resistance is 1050 ohms per circular mil foot, the vibration damping constant is 2.3 per cent, and the thermal conductivity is only 2 per cent of the value for copper.

G. E. Type HAP Battery Cutout

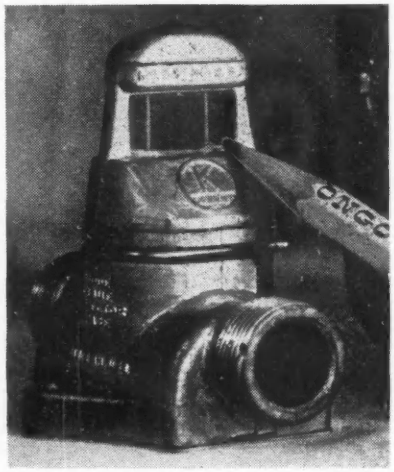
The type HAP automatic battery cutout, for use in ship service and other applications where batteries are charged from generators, is the latest addition to the line of cutouts offered by the General Electric Company, Schenectady, N. Y.

This relay performs practically the same function as the circuit cutout device in an automobile. When the battery voltage is lower than the voltage of the charging source, the relay closes the charging circuit. When the charging voltage drops to a value below the battery voltage, the Type HAP cutout relay opens the circuit on a small reverse current.



The G-E Cutout Relay, Type HAP, With Cover Removed

Continuous current ratings available are 2.5, 4, 6.5, 10, 16, 25, 40, 65 and 100 amp. Voltage ratings are 7.5 volts for 3-cell batteries to 300 volts for 120-cell batteries. The relay is set to pick up at slightly below the normal charging voltage.



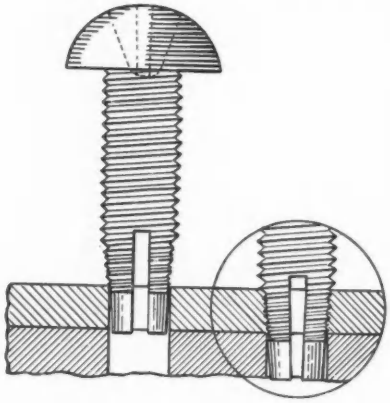
Kidde Flame Detector

New Fire Detector

A method of detecting fires and setting off automatic extinguishing systems is a late development of Walter Kidde & Company, Inc., Bloomfield, N. J. The basic element consists of two organic filaments holding an electrical circuit open. At the slightest contact with flame these filaments are destroyed and the circuit is closed. As an extra precaution, there is a fixed-temperature thermostat in the flame detector, but this is set high enough to over-ride operating temperature conditions.

"Tap" Screw Developed by Continental Screw Co.

A self-tapping screw which features a smooth pilot point below tapered threads and a complete slotted opening at the entering end, is announced by the Continental Screw Co., New Bedford, Mass. The smooth pilot point effects an aligning and holding action when the screw is applied, and the slot produces a cutting edge that simulates the cutting action of a tap. These new "Tap" screws are furnished with slotted heads or Holtite Phillips heads. They are protected by Pat. No. 2,292,195.



Continental Screw Company's "Tap" Screws

Dry Powder Type Fire Extinguisher

A fire extinguishing unit manufactured of matedials not essential to the war effort and approved by the Underwriters' Laboratories, Inc., is being offered by the duGas Engineering Corporation, Marinette, Wis. It uses a dry powder which is approved for use on fires in gasoline, alcohol, oils and other flammable liquids. It is also approved for use in electrical equipment, as the powder is a non-conductor of electricity.

duGas Fire Extinguisher made of non-critical materials.

Commercial *t*-Butyl Hydroperoxide

The Union Bay State Company, Cambridge, Mass., recently announced the availability of Commercial *t*-Butyl Hydroperoxide, a formulation of *t*-Butyl Hydroperoxide, an unusually stable liquid with an active oxygen content of 17.8 per cent at 100 per cent concentration, which can be handled and shipped in large quantities without danger of explosion from shock. It is soluble in many common organic solvents such as alcohol, ether, ketones in general, esters, aromatics and petroleums, slightly soluble in water, and is comparatively stable in the presence of various alkalis and acids. Standardized at a concentration of 50-60 per cent, Commercial *t*-Butyl Hydroperox-

(*Turn to page* 93, *please*)

"Scrap" orders Frank Baker, general purchasing agent of Pullman-Standard Manufacturing Co., on his tour with L. C. Reed, chairman of the Chicago district dormant scrap campaign.

Mark it SCRAP—Mr. President

● So long as this war lasts the problem of scrap supply will confront America's steel mills. That is why we are again appealing to you presidents of manufacturing companies to use all your influence and all your official authority to move the dormant and potential scrap that remains about your plants.

Yes, we know you have had scrap drives, that you have had diligent scrap committees at work for months. They have done a fine job. But after all is said and done their authority is limited. Many of the things that can and should be marked scrap, under today's standards and necessities, are the very things which you, or other officials, may have designated only a few years ago as "standby," or "reserve." Maybe releasing some of this potential scrap is a matter of capital account. In any event it will require your countermand of old instructions, and orders from you to establish new company policies, so that surplus and unneeded machinery, spare parts, processed parts, etc., will reach steel mills as vitally needed scrap.

The next move is yours, Mr. President—mark it "scrap" today so our fighters will have the guns, the planes and the tanks they need to win.

ARMY E NAVY

Dedicated to Victory

INLAND STEEL CO.

38 S. Dearborn Street, Chicago · Sales Offices: Milwaukee, Detroit, St. Paul, St. Louis, Kansas City

Aircraft Engine Output Ahead of Plane Production

Lend-Lease Received Approximately One-Third of Tanks and Combat Planes Produced in 1942

Donald M. Nelson's WPB report on December war production revealed that armament deliveries stepped up 14 per cent over November. This eclipsed the 12 per cent gain in November and sent the WPB munitions index soaring 62 points to 497, compared to a 100 base for the month prior to Pearl Harbor. Aircraft output was up 20 per cent as 5,489 planes were delivered to the government. This compared with 4822 planes delivered in November. Several hundred of the planes classified as delivered, however, went into an aircraft "pool" on Dec. 31, composed of planes which lacked some parts. Ground ordnance production, such as tanks, combat vehicles and artillery, increased 25 per cent in December and miscellaneous munitions like trucks and machine tools increased 11 per cent.

The report indicates a possible temporary cutback in aid to aircraft engine production. Pointing out that the output of engines is running ahead of plane production, it states that at some points storage for finished engines has become a problem. Steps have been taken to see that some of the metal going into surplus engines is put into airframes and airframe parts. Aluminum and alloy steel forgings remain a bottleneck. There continues to be inadequate procurement of airplane component parts and accessories, including many items of government furnished equipment. Despite this unbalance, December production of combat planes rose 16 per cent. Service planes in the observation and transport classes gained 26 per cent, and trainer output was up 32 per cent.

The report stated that tank output reached its peak in December, and is scheduled to decline in 1943. Output of self-propelled guns (tank destroyers) advanced 25 per cent in December, while the infantry weapons, aircraft guns and anti-aircraft guns, all showed substantial increases. Machine tool production reached a new peak of $131,900,000, slightly more than the October record of $131,000,000. However, Nelson cautioned that the December showing was partly the result of a year-end drive to clear up odds and ends in many shops and because of this the January production totals probably would suffer. He warned that each increase in monthly production from now on will be harder to obtain.

More than 150,000 trucks, jeeps and other motor vehicles were shipped by the U. S. to other of the United Nations during 1942, according toi the annual report of E. R. Stettinius, lend-lease administrator. They were among $5,637,000,000 worth of goods transferred

(*Turn to page 62, please*)

Consolidated and Vultee Unite

Merger of Vultee Aircraft Inc. and Consolidated Aircraft Corp. was approved by directors of both companies and recommended to stockholders in one of the most far-reaching aviation developments of the war.

One of the world's largest aircraft manufacturing enterprises, the new company will be known as the Consolidated-Vultee Aircraft Corp., according to Tom M. Girdler, chairman. The recommendation of the directors will be acted upon by the stockholders, March 17, at their annual meeting.

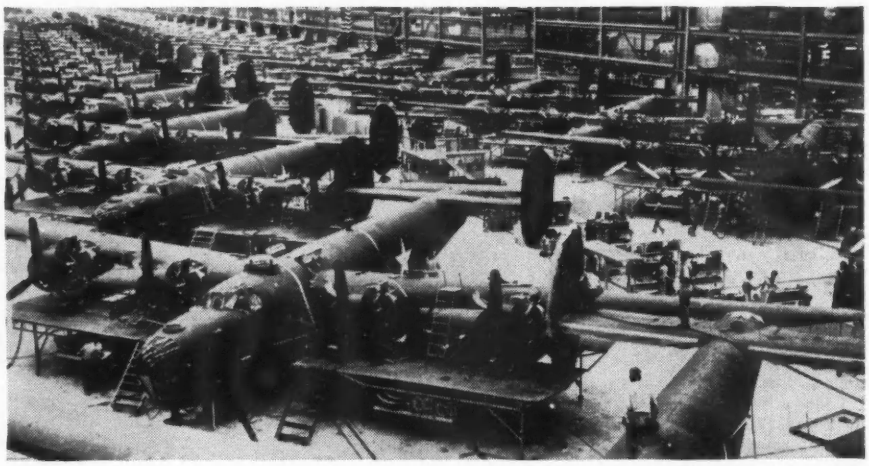
Light Planes Frozen

All single-engined aircraft of five hundred horsepower or less, and all "link trainers," have been frozen in the hands of their present owners by General Limitation Order L-262. The order applies to all individuals and organizations, except the Army or Navy of the United States, any United States Governmental agency, any air carrier holding a certificate of necessity from the Civil Aeronautics Board, or any manufacturer of aircraft.

Bendix Renegotiates War Contracts

Through renegotiation of war contracts, the Bendix Aviation Corp. has returned $188,400,000 to the government, according to the annual report to stockholders by President Ernest R. Breech. Price reductions, made possible by mass production methods, began last February and amounted to $123,000,000 as of Sept. 30, the end of Bendix's fiscal year. An additional $65,400,000 has been refunded to the government as a result of renegotiating the year's profits as required by law.

Bendix war production has increased to 20 times that of pre-war levels and about one-third of this increase has been in new devices that were not even on the market in 1938 but have been developed in the Bendix laboratories. A modern bomber requires more than 150 devices manufactured by Bendix.



International News photo

Hundreds of planes being rushed to completion at the Fort Worth plant of Consolidated Aircraft Corporation. The B-24 bombers in the foreground are being equipped with their armament. The assembly line in the background, filled with C-87 transports, is said to be the longest straight mechanized assembly line in operation in the aircraft industry.

Simple guard for power drills improves operation

Information supplied by an Industrial Publication

Safety in small things as well as great is an excellent policy for manufacturing plants today. Adding safety devices to small power driven hand tools has the same results as the same procedure on heavier machines. Operators can work better because their attention is undivided.

That was the idea behind a guard for power driven hand drills devised by a worker in an airplane factory. He noticed that hole spotters sometimes got pinched fingers when the drill suddenly punched through the work.

The guard is very simple. It consists of a steel sleeve set into the drill chuck surrounding the shank of the drill bit. It is easy to attach, and it could be made from scrap tubing, or bar stock cutoffs with a minimum of machining.

In operation, when the drill goes through, the guard brings up against the work, and stops forward motion of the tool. It is long enough so that the operator's fingers cannot be caught between the work and the drill body. As a result slowing down caused by the operator's natural tendency to flinch is eliminated.

Windshield Protects Pilots from Birds

An aircraft windshield which will protect pilots against collisions with birds in flight, and against the accumulation of ice, promises to become a reality as the result of a development program carried out by the CAA and a group of commercial companies during the past year.

The research was directed by John Easton, chief of the CAA's Technical Development Division and by A. L. Morse, chief of the Aircraft Development Section of that Division. Technical experts from E. I. du Pont de Nemours & Company and the Monsanto and other chemical companies provided plastics, while engineers of the Pittsburgh Plate Glass Company and Libbey-Owens-Ford Glass Company prepared the glass and did the laminating.

One promising type of panel is made by laminating a sheet of a specially prepared "Butacite" polyvinyl acetal resin one-half inch thick between two panes of semi-tempered glass, each one-eighth inch thick. The amount of plasticizer used is adjusted to provide a maximum of toughness at the temperatures maintained during flight. The plastic sheet extends about an inch beyond the glass and is bolted to the metal framework of the airplane. A scratch-resisting plastic may be substituted for the rear glass plate.

The windshield includes a front pane of one-quarter inch tempered glass, separated from the panel by a narrow air space through which hot air can be circulated.

Truman Committee Divides Steel Shortage Responsibility

Price Reduced for Aluminum, Magnesium and Copper Base Castings. More Die Castings to be Used.

By W. C. HIRSCH

With the initial task under the Controlled Materials Plan, that of the 14 claimant agencies notifying producers of steel and the other critical materials of their requirements during the second quarter of the year, supposedly out of the way and scheduling of commitments to take care of their third quarter needs due to be completed by March 1, suggestions for simplification and curtailment of the necessary paper work bob up daily. An estimate of usable inventory expected to be in the manufacturers' hands on March 31 forms an important part of the required information, and the relative character of such data causes some misgivings as to the plan's results.

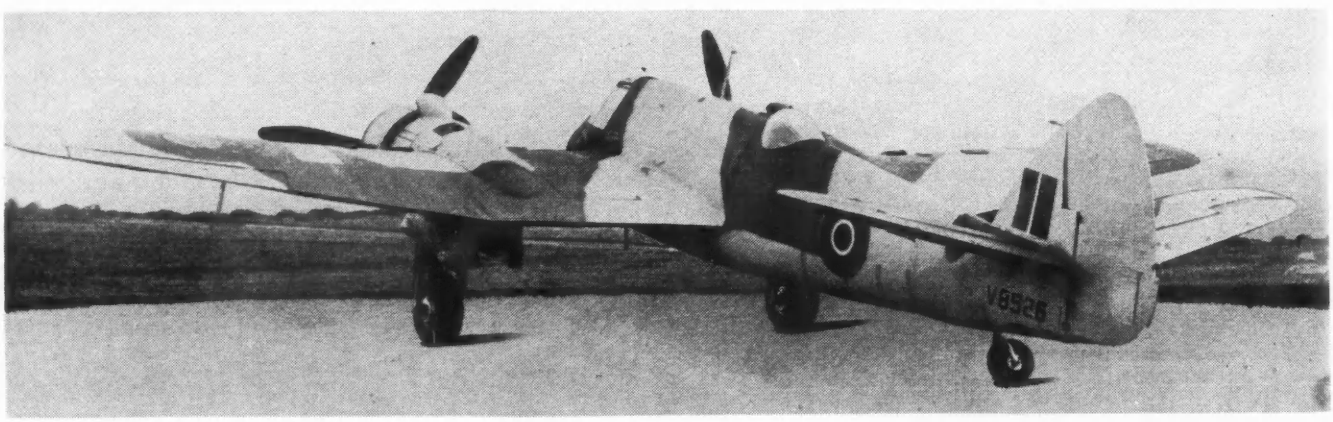
The Truman Committee report, which divides responsibility for the inadequacy of steel supplies between Government agencies and the steel industry, the latter because it sought to prevent excess steel-making capacities after the war, is regarded in the steel market as a strictly political document, and devoid of anything new. After all, steel company executives in 1941—before Pearl Harbor — did only their bounden duty toward their employers, their companies' stockholders, in opposing what then looked like overexpansion. Recognition of the fact that much vital material and manpower needed elsewhere would have been needed in the construction of more additions to steel-making capacity than were undertaken, was, however, partly responsible for their attitude.

Announcement by the War Production Board of a new plan of rigid inspection and certification of high quality zinc and aluminum die castings portends greater use of this process in the production of important assembly parts. Spectrographic and X-ray eye inspection of special quality zinc die-castings is required under their certification plan, which because of the difference in the character of the two metals, will be conducted separately for zinc and aluminum. Ordinary castings also figured in the Washington news recently. Reductions of 3 cents per pound for aluminum castings, 3 cents per pound in the price of magnesium and 1½ cents per pound in that of copper base castings will, according to the OPA, save $25,000,000 a year to the Government and other consumers.

Considerable opposition is developing to the plan of sending a labor mission to Bolivia to investigate the causes of the recent strike of tin miners in that country. Bolivians point out that it is not customary for one government to investigate the internal affairs of another, and in well informed circles it is said that tin concentrates are arriving from Bolivia in normal tonnages, so that what production difficulties there were, have been adjusted. It is also said that there is no need of increasing at this time the production rate of the smelter owned by the United States Government, reserve stocks of tin being considered adequate.

Additional Facilities for Douglas and Liberty

Douglas Aircraft Co., Inc., has received a Defense Plant Corp. commitment for $1,565,000 to provide additional facilities in California, increasing the total contract to approximately $10,600,000. Liberty Aircraft Products Corp., Long Island, N. Y., received an award of $180,000 for a new plant in New York State, upping total commitments to $2,170,000.



Beaufighter Type I

A Bristol Beaufighter of the series now in production. The chief variation from the preceding series is the provision of dihedral angle for tail planes. The dihedral, by keeping the tail clear of the disturbed air, is said to have greatly improved the stability of this long range fighter. The plane illustrated has the Bristol Hercules III 14-cyclinder sleeve valve radial engines, each developing 1400 hp. for take-off, and fitted with a two speed supercharger.

IT WON'T BUDGE!

GASOLINE, KEROSENE, FUEL OIL, HOT LUBRICATING OIL, HOT WATER, SALT WATER, ANTI-FREEZE SOLUTION . . . NONE OF THESE LIQUIDS WILL MAKE A FILM OF FORM-A-GASKET MOVE FROM POSITION, MELT OR DISSOLVE!

Permatex Form-A-Gasket used in automobile and aircraft engines is available in three types.

FORM-A-GASKET NUMBER 1 IS A PASTE THAT DRIES FAST AND SETS HARD.

FORM-A-GASKET NUMBER 2 IS A PASTE THAT DRIES SLOWLY AND REMAINS PLIABLE.

AVIATION FORM-A-GASKET IS A HEAVY LIQUID THAT SETS QUICKLY AND DOES NOT DRY.

These three Form-A-Gasket products are used in many industries wherever leakproof, pressure-tight flange unions, gasket assemblies or screw thread connections are required.

PERMATEX COMPANY, INC.
Sheepshead Bay, N.Y., U.S.A.

Ordnance Department Transfers Maintenance Branch to Detroit

Maintenance Branch of Tank Automotive Center to Control 17 Base Shops, Standardize Procedure

Transfer of certain maintenance activities of the Ordnance Department from Washington to the Tank Automotive Center at Detroit has been announced by Brig.-Gen. A. R. Glancy, chief of the center. The Maintenance Branch of the Tank Automotive Center under Col. S. E. Reimel, will assume control of the 17 ordnance base shops for repair and maintenance, tools and equipment for repair shops, both fixed and mobile, and the preparation of manuals of instruction on maintenance and repair. About 200 persons will be involved in the transfer.

This transfer is part of a general program of the Ordnance Department to bring motor vehicle and parts manufacturers together to draft a standard operating procedure to be used in writing shop manuals and training personnel in ordnance and manufacturers' schools. Preliminary organizational meetings have been held at Camp Holabird, Md., and Detroit, to form working groups of vehicle and component manufacturers to further this program, which was proposed by Brig. Gen. James Kirk, chief of Field Maintenance for the Ordnance Department in a speech before the annual meeting of the SAE last month at Detroit.

The ACWP cooperated in helping form a top coordinating committee composed of policy officials of the manufacturer companies, with an Ordnance officer as chairman. There will be three major working committees, engineering, service education and preventive maintenance. Each working committee will be divided into three sections, for light, medium and heavy vehicles. Each section will have a parts supplier sub-committee. Col. T. L. Preble, chief of the Preventive Maintenance Section of The Ordnance Department and Lieut. Col. A. C. Bigelow, in charge of similar activity at Camp Holabird, will be active in this program.

The program of developing standard operating procedures will prove of great aid in keeping in service the greatest truck fleet in the world, that of the U. S. Army. Development of standard nomenclature for parts for use in service manuals and in shop educational courses also will be sought. Similar to this will be the cross indexing of parts numbers to eliminate the confusion that duplication has brought. As an example, it was found that the bearings in generators had nine different parts numbers. All this work of coordination and simplification, it is hoped, will be accomplished in a series of 58 sessions by each committee section at Detroit, wherein a different vehicle component will be discussed at each session.

Value of shifting the Ordnance Department's motor vehicle activities to Detroit and setting up the Tank Automotive Center was cited recently by Major General L. H. Campbell, Jr., chief of ordnance, when he said, "The results achieved thus far convince me emphatically of the wisdom of shifting the national headquarters for Tank Automotive activity from Washington to the natural center of the motor industry—Detroit. I believe it is the largest single stroke of decentralization yet done in this war. Tank Automotive Center has worked out to great advantage both to the Ordnance Department proper and to the factories making tank automotive equipment."

General Glancy estimated that the Detroit operations are being performed with a saving of about 700 in personnel as compared with the same work done in Washington.

Acme

This Cadillac-built M-5 light tank is reported to be the fastest track vehicle in the world. Some of these tanks already have seen action against the Nazis in North Africa. Cadillac is building these M-5 tanks at Detroit and at the GM plant at Southgate, Cal.

Business in Brief

Written by the Guaranty Trust Co., New York, Exclusively for AUTOMOTIVE AND AVIATION INDUSTRIES

Somewhat broadened fluctuations of general business activity have been indicated. The seasonally adjusted index of *The New York Times* for the week ended Jan. 23 dropped to 133.3 per cent of the estimated normal from 138.8 for the preceding week, as compared with 139.7 a year ago. The index of *The Journal of Commerce*, without seasonal adjustment, for the same period declined to 128.1 per cent of the 1927-29 average from 129.7 a week earlier.

Department store sales during the week ended Jan. 30, as reported by the Federal Reserve Board, equaled the corresponding level in 1942. For the period of four weeks then ended, the total was 2 per cent greater than a year ago.

Railway freight loadings during the week ended Jan. 30 totaled 734,582 cars, 4.4 per cent more than for the preceding week but 9.9 per cent less than the number a year earlier.

Electric power output during the same period rose contra-seasonally and was 14.7 per cent greater than a year ago, as against a similar excess of 15.5 per cent shown for the week before.

Crude oil production in the week ended Jan. 30 averaged 3,826,400 barrels daily, 22,600 barrels below the figure for the preceding week and 297,800 barrels less than the average output recommended by the Petroleum Administration for War.

Average daily production of bituminous coal during the week ended Jan. 23 was 1,875,000 tons, as compared with 1,900,000 tons in the week before and 1,833,000 tons a year ago.

Engineering construction contracts awarded in the week ended Feb. 4, totaling $81,796,000, were 49 per cent below the corresponding figure in 1942, according to *Engineering News-Record*.

Business failures in the week ended Jan. 29 numbered 138, as compared with 114 in the preceding week and 248 in the comparable period last year, according to the Dun & Bradstreet report.

Professor Fisher's index of wholesale commodity prices for the same week rose one fractional point to 110.3 per cent of the 1926 average, as against 102.6 a year ago.

Member bank reserves declined $336,000,000 during the week ended Feb. 3, and estimated excess reserves fell $390,000,000 to a total of $1,700,000,000. Business loans of reporting members declined $16,000,000 in the preceding week and stood $838,000,000 below the total a year earlier.

New Chevrolet Plant Added

Negotiations have been completed for the acquisition of the American Steel and Wire Company plant in Anderson, Ind., it was announced by M. E. Coyle, general manager, Chevrolet Motor Division. Aluminum forgings for aircraft engines will comprise the output of this plant. Immediate remodeling and rearrangement of this property to accommodate the large presses and furnaces used in forging aluminum are contemplated.

"Dog Fights" are won on the Ground!

● Finer skill and training of United Nations' pilots and crews . . . superior plane design and construction . . . valves and valve seats in the engines ground to a finer precision and finish . . . that's why "dog fights" are won before the planes leave the ground.

● We are extremely proud that HALL Wet Type ECCENTRIC Valve Seat Grinders and Wet Type Valve Refacers are the preferred equipment in both factory and field; that their speed and precision are not only getting and keeping more planes in the air, but are providing those planes with the extra speed and power they need when they need it.

THE HALL MANUFACTURING CO., Toledo, Ohio

1. Model AW ECCENTRIC; 2. Model AWA ECCENTRIC Valve Seat Grinders; 3. Model 80A Wet Type Aero Valve Refacer. Information on these and other HALL Models on request.

HALL

The new Curtiss dive-bomber which has successfully passed its factory flight tests and has been delivered to the U. S. Army Air Forces at a Missouri plant of Curtiss - Wright Corporation. This plane is said to possess greater speed, range and striking power than any dive-bomber now in action.

War Plant Expansions

General Motors Corp. has received a commitment from the Defense Plant Corp. for approximately $12,000,000 for machinery and equipment for a plant in Michigan. Another contract award has been made to GM for $900,000 for further expansion of another Michigan plant, bringing the total commitment to more than $2,500,000. Briggs Mfg. Co. has been granted $700,000 by DPC for equipment for a Michigan plant, boosting the over-all cost to the government to $5,700,000.

A. O. Smith Corp., Milwaukee, has received a DPC contract for $23,000,000 to provide manufacturing facilities in Wisconsin. Briggs & Stratton Corp., Milwaukee, has been awarded $900,000 to provide equipment for a Wisconsin factory. American Bosch Corp., Springfield, Mass., has been allocated $350,000 for additional equipment for a Massachusetts plant, bringing the total cost to more than $3,000,000.

Employment of Women May Help To Solve Labor Shortage Problem

Detroit Will Lose About 80,000 War Plant Workers to Selective Service System in 1943

Detroit is scheduled to lose between 70,000 and 90,000 men between the ages of 18 and 38 to the Selective Service System in 1943 and a large proportion of these men going into the armed forces will be war plant workers. This accentuates the problem of the War Manpower Commission in getting enough able workers to keep Detroit's many war plants operating at top speed this year. Metropolitan Detroit industrial employment totaled 677,000 workers in January. According to preliminary estimates by the WMC, this total will rise to 766,000 workers by July, then increase more gradually to a peak of 799,000 in January, 1944. However, the entire war picture is changing so rapidly that these estimates may be obsolete in a few months. Manufacturers are inclined to overestimate their labor requirements for the sake of being on the safe side. There also is the case of technological improvements, making for more efficient production, as exemplified by a propeller plant in the automotive industry whose labor needs are 40 per cent less than anticipated due to improved manufacturing methods. Material shortages also tend to restrict production and cut employment. Then the present global war is so fluid in character that demands for weapons and equipment are constantly changing and it is hazardous to project the production schedules of any plant more than a few months ahead.

Additional women in war work are expected to help solve the Detroit labor shortage. Detroit's 185 major industrial plants employed 83,000 women in December and this was 15.6 per cent of total employment. Another 55,000 women will be needed to help fill the industrial ranks. In June, 1942, only 8.6 per cent of employment in the 185 major plants was women. In November and December 75 per cent of the newly hired workers in Detroit factories were feminine. Among the skilled war jobs filled by women are inspectors, arc and acetylene welders, tube drawers, firearm assemblers, engine lathe operators, automobile painters and gear generator operators. Semi-skilled jobs for which women are fitted include gaugers, hand burrers, foundry workers, general assemblers, aircraft riveters, screw machine operators, punch press operators, milling machine operators, drill press operators and forming press operators. Last summer 363,000 Detroit women filled out questionnaires about their availability for war work and the 55,000 needed are expected to come from this group. More war workers are expected to be obtained through Paul McNutt's order of Feb. 2 in which 34 occupations, 19 manufacturing industries, eight wholesale and retail trades and nine service activities were declared unessential. Men in these jobs have been given until May 1 to seek places in war industry or face induc-

(*Turn to page* 82, *please*)

Automobile Dealers Reject Nugent Plan

The National Automobile Dealers Association has taken a definite stand against the much-discussed Nugent Plan, which, if adopted by the Government, would permit the immediate sale, under Federal Reserve System supervision, of automobiles, refrigerators, pianos and other durable goods to be delivered on a priority basis and at a discount after the war. Official action disapproving the plan was taken by N.A.D.A. at Cincinnati recently. This is the first nation-wide group of retailers to take a stand against the Nugent Plan.

Taylor Joins North American Aviation

Robert Taylor, who prepared the article "General Principles of Industrial Radiography," which appeared in the February 1, issue of AUTOMOTIVE AND AVIATION INDUSTRIES, is now supervisor of X-ray inspection control at the Dallas plant of North American Aviation, Inc. Mr. Taylor was formerly supervisor of X-ray and inspection at the Illinois Division, Bendix Aviation Corp.

Chris Sinsabaugh

Chris Sinsabaugh, 71, well known to the automobile industry as a reporter and editor for more than 40 years, died at his home in Detroit January 26. For the past 12 years he had been editor of the Automotive News. Prior to that he had been at various times editor of *Motor Age*, *Motor*, *Motor Life*, and the *American Motorist*.

More power to you, Soldier!

You have the physical power it takes and the brain power and the fighting heart. Your country will see that you have the gun power and the engine power needed to win battles in this age. We at Sealed Power are mighty proud of you—and proud, also, of our assignment to furnish piston rings, pistons and cylinder sleeves for the tanks, trucks and jeeps on which your life may depend. Our engineers and craftsmen are working to insure the utmost dependability of your engines in every climate under battle conditions.

More Power to You, Engine-Builder!

Your inspectors' mikes and gauges and your laboratory testing tell you constantly how true to specification and standard are the good Sealed Power parts you're installing in the magnificent fighting engines you're building! Your work and your watchful care are an inspiration to the nation you serve.

SEALED POWER CORPORATION

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BUY MORE WAR BONDS

PISTON RINGS—PISTONS—CYLINDER SLEEVES

DOUBLE YOUR PRODUCTION

With the new WILSON "HONEY BEE" ARC CONTROL STATION

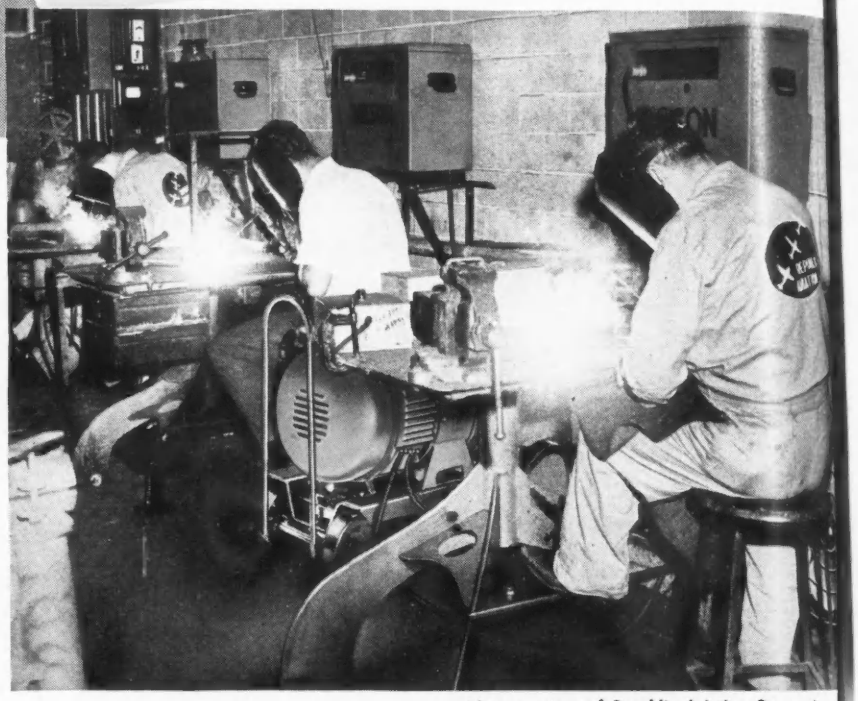


Photo courtesy of Republic Aviation Corporation.

By connecting two or more Wilson "Honey Bee" Arc Control Stations to one constant potential arc welding generator you can double or triple your welding production without additional generators. At the same time you assure better quality welds on light or heavy gauge metal because of the finer arc control provided by the Wilson "Honey Bee."

Several 150 amp. or 75 ampere Wilson "Honey Bees" can be connected to one 300 amp. constant potential arc welding generator up to the maximum load capacity of the generator. This multiplies the number of welding operations that can be performed simultaneously from a single generator, thereby increasing the welding output of every machine. A better load factor results, with more welding for every K.W.H. of power purchased.

Operators at each Wilson "Honey Bee" station have full control over their individual welding current. Changes in individual welding currents do not affect other stations working from the same generator.

Infinite adjustments of current may be made without production delays by means of a remote control switch which may be combined with the electrode holder. Wilson Crater Control provided with each "Honey Bee" Station fades out the arc slowly to prevent craters, porosity and gas pockets that result from the abruptly broken arc.

For full details on the new Wilson "Honey Bee" Arc Control Station write for Bulletin ADW-47 or get in touch with your nearest Air Reduction Sales Office.

WILSON WELDER AND METALS

General Offices: 60 East 42nd Street, New York, N. Y.

OF HIGH-QUALITY WELDS

Here are valuable pointers to help you conserve electrodes and increase production

ELECTRODES

1. For vertical and overhead welding use an A.W.S. E-6010 or E-6012 type electrode. This type of electrode produces little slag so that there is a minimum of interference with the operator's manipulation of the electrode.

In addition it produces a large amount of "gas" which protects the molten metal from oxides and nitrides in the air.

2. For groove welding in flat position and horizontal fillets use a hot rod—one that produces a heavy slag, such as A.W.S. E-6020 and E-6030. Hot rods for "downhand" welding will increase the welding speed up to 200%-300%, since the high currents that can be used will permit increased penetration, higher burn off rate and a higher deposition rate.

MACHINES

1. Keep the machine protected from weather exposure at all times. Most welding machines are drip proof but not water proof. Do not store machine in a room where paint spray, dust, metal particles or foundry dust may be blown around.

2. Be sure that bearings are properly greased. Refer to manufacturer's operating instructions.

3. Do not overload your machine. For instance, do not use the machine continuously above its rated capacity. This is a harmful practice that decreases the life of your machine and results in overheating and charred insulation. Selection of proper size welding cables is important because excessive voltage drop in cables will result in overloading.

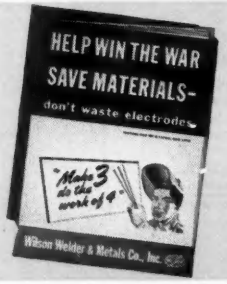
4. Check the brushes periodically to be sure they make proper contact with the commutator.

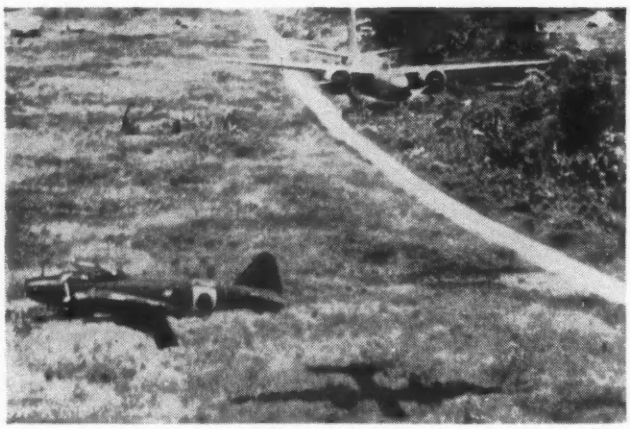
5. Check all connections regularly to insure perfect contact. Loose connections may cause erratic operation of the machine and unnecessary delays in production.

CO., INC.

CONSERVE WELDING ELECTRODES

Write for free copies of this helpful booklet. It contains six shop bulletins emphasizing important ways to prevent electrode waste.





Acme

An American A-20 flying over a disabled Jap bomber at Lae, New Guinea. The American plane is only about 100 feet above the ground.

CALENDAR

Conventions and Meetings

Natl. Standard Parts Assoc., Chicago, Winter Conference.....March 2-5

American Society of Tool Engineers, Milwaukee, Annual Meeting March 25-27

Midwest Power Conference, Chicago April 9 and 10

American Chemical Society, Detroit, Annual Meeting .....April 12-16

American Foundrymen's Association, St. Louis, Annual Meeting..April 28-30

Improved Process for Making Neohexane

Standard Oil Company (Indiana), has announced that a new process for the manufacture of neohexane has been developed in its laboratories.

Neohexane is one of the almost innumerable combinations of carbon and hydrogen atoms obtainable from petroleum. Like iso-octane it will burn without knocking in high compression engine cylinders. On this account it is regarded as one of the best materials to blend with other petroleum derivatives to make fuels for high-powered airplanes.

Since neohexane occurs in crude petroleum in very limited quantities, if at all, it must be made synthetically. In this new process atoms of other and more common hydro-carbons are shoved around by the methods known best to chemists and refinery technologists to arrange them in the pattern which distinguishes neohexane.

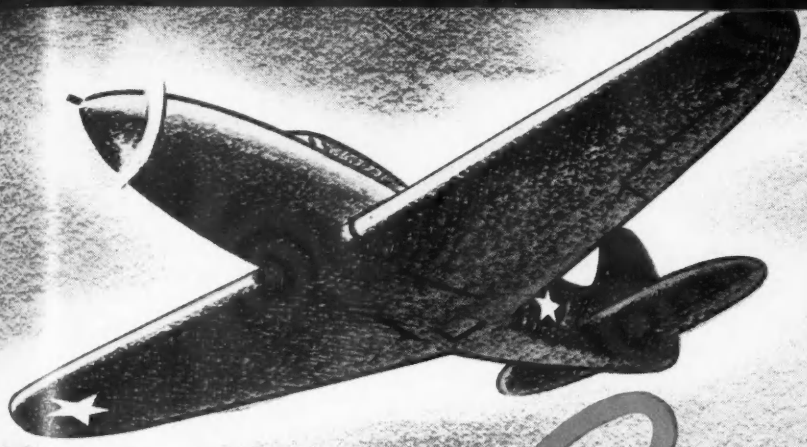
In the past the transformation has not been an easy or cheap one. While the new process discovered in Standard's laboratories will not by any means make neohexane as abundant or cheap as ordinary gasoline, it is said to offer promise for increasing economically the quantity and the quality of high octane aviation fuels.

The new process resulted, according to Standard, from further work carried out by its research staff on the naphtha isomerization process. The naphtha isomerization, or "isomate" process is a way of converting ordinary naphthas into an improved product. The "neohexane" process gives a product of still higher octane number.

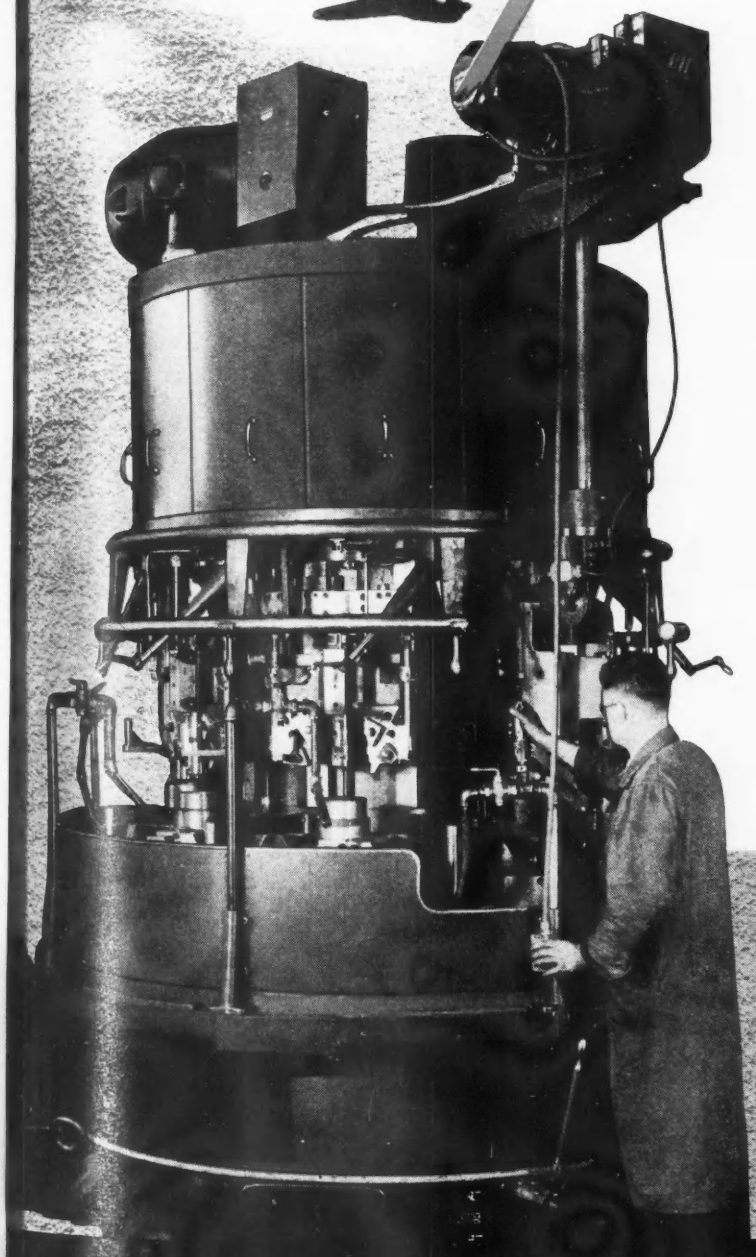
New Catalytic Process for Super Aviation Fuel

Development of a new catalytic process which will produce increased quantities of a great superior high octane aviation fuel was announced by Eugene J. Houdry, President of Houdry Process Corporation, Washington, D. C.

Comprising an adiabatic catalytic cracking method, the new Houdry process produces from heavy naphtha



How Many... TO WIN?



Right now, only two things seem certain.

We'll have to count America's best fighters and bombers by the thousands. AND THE SOONER WE LAUNCH THEM, THE QUICKER WE'LL HAVE THE VICTORY.

Many of you are producing parts for these planes with Bullard Mult-Au-Matics. You know already that with the Mult-Au-Matic each one of your men can do the work of 8 using single spindle machines. That's speed. That's conservation of man-power.

Our engineering staff is eager to help you reach your very highest production. That way lies the quickest road to victory.

ARMY E NAVY

BULLARD

Type "D" MULT-AU-MATIC machining three way propeller hub

THE BULLARD COMPANY

an aviation fuel said to be of higher octane equivalent than has ever been produced. Indeed, the quality of the gasoline is so high that it is ahead of currently developed engines. For the time being, therefore, its chief value will be to raise the octane rating of presently produced aviation fuels. The process paves the way for further raising of standards for aviation fuel.

By utilizing heavy naphthas, now in large quantities a drug on the market, the process will make possible increased production of aviation fuel without increasing the need for crude oil production or placing a further drain on crude oil transportation facilities.

The Houdry adiabatic process was developed early last year in the search for an economical, certain method for making butadiene, main ingredient of Buna S synthetic rubber. The principle was tested in a semi-commercial butadiene plant built several months ago by the Sun Oil Company. This was the first plant to be completed demonstrating the feasibility of producing butadiene by a catalytic process on a reasonably large scale, with perfect control and without operating difficulties.

Houdry scientists thereupon turned their attention to adapting this adiabatic principle to the production of aviation fuel by catalytic cracking. They completely developed the process on a pilot plant scale with startling results. Engineering and construction of commercial units are now under way.

Technical details of both new aviation fuel and butadiene process must be kept secret for military reasons. However, this much can be said: The enemy of all catalytic processes for cracking oils and gases is carbon, which impairs catalytic activity. Houdry scientists developed the technique for turning this troublesome factor into an advantage. This method converts the carbon deposit on the catalyst into heat necessary to rearrange the hydro-carbon molecules into the desired product, in this instance, super aviation fuels, without the use of materials for equipment to handle extraneous heat exchange.

Obituary

John J. McQuade, a member of the board of directors of the Johnson Bronze Company, died at New Castle, Pa., on Jan. 26. Mr. McQuade was connected with Johnson Bronze for 29 years. The first 20 years were spent in the sales department and the last 9 at New Castle.

E. S. Harrington, secretary and treasurer of Turco Products, Inc., died Jan. 16 of a heart attack at his home in Los Angeles, Cal.

Harold F. Whitmore, field sales executive for the Hudson Motor Car Co., died Jan. 19 in Cincinnati, Ohio, after a brief illness. For the past 16 years, Mr. Whitmore had been connected with Hudson, acting successively as district manager, special representative and regional manager.

Richard Flint Howe, one of the founders of the International Harvester Company, died Jan. 26 at Aikens, S. C.

Theodore A. Willard, 80, inventor of the Willard storage battery, died Feb. 3 at Los Angeles. He held more than 57 patents on storage batteries and was president of the Willard Storage Battery Co., Cleveland, until his retirement in 1928.

Arthur A. Burgess, 60, superintendent of the Chevrolet Grey Iron Foundry, Saginaw, Mich., died Jan. 25 at Saginaw. He was with the Mason Motor Co. before joining Chevrolet in 1913 and he went to Saginaw in 1935.

Seymour Benton Cochrane, regional manager for the South Bend branch of The Studebaker Corporation, died Jan. 24 in his home in South Haven, Mich.

Walter C. Keys, 57, chief engineer of the new products dept., mechanical division, of U. S. Rubber Co., died Jan. 25 at Detroit after a short illness. He had been associated with Cadillac, the Standard Parts Co. and the Gabriel Corp. before joining U. S. Rubber in 1927. He was a member of the SAE.

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BOOKS . . . .

AEROSPHERE 1942, *published by Aircraft Publications, 370 Lexington Ave., New York, N. Y.*

This annual, now in its third edition, again contains four principal sections, devoted respectively to Modern Aircraft, Modern Aircraft Engines, Aircraft Statistics, and a Buyers Guide or Directory. In the sections on Modern Aircraft and Modern Aircraft Engines are given illustrations and specifications of airplanes and engines in production in all parts of the world, so far as the material has been available. The third section contains a large number of statistical data relating to aviation organizations, performances and activities, principally in the United States. The Buyers Guide contains a U. S. alphabetical listing, a U. S. product listing, and a U. S. geographical listing, besides listings of firms in a number of foreign countries. Two special features of the current edition are a number of "guest editorials" by leaders of the U. S. Air Force, dealing with the war efforts of this country in the air, and a section on Aircraft Armament in which all types of aircraft weapons and ammunition are dealt with by a specialist.

JORDANOFF'S ILLUSTRATED AVIATION DICTIONARY, *by Assen Jordanoff. Published by Harper and Brothers, New York.*

This dictionary gives definitions of some two-thousand terms used in aviation, an illustration accompanying each definition. The book should be of great help in enabling novices to familiarize themselves with the technical terms of aviation and the aviation industry. It covers a very wide field, including terms used in connection with planes, lighter-than-air craft, internal combustion engines, electrical equipment, radio equipment, etc., and in such sciences as meteorology, navigation, aerodynamics, etc. On the whole the work seems to be very well done, and the illustrations for the most part are sharp and clear.

HIGH-SPEED DIESEL ENGINES FOR AUTOMOTIVE, AERONAUTICAL, MARINE, RAILROAD AND INDUSTRIAL USE, *by P. M. Heldt. Fourth Edition. Published by P. M. Heldt, Nyack, N. Y.*

This fourth edition of Heldt's book on Diesel engines has been completely revised, and as this is the first complete revision in nearly seven years, much new material has been added. When this book first appeared, the high-speed Diesel had only just made its debut in this country, and the book dealt largely with European developments and productions. But with each successive edition more space has been devoted to Diesel engines of American design and to results of American Diesel research, while material relating to earlier European work has been deleted. The new edition contains new material particularly on Diesel fuels, the cooling of injection nozzles, injection pumps, governors, two-stroke engines, supercharging and lubrication. Special chapters are devoted for the first time to each of the last two subjects, viz., supercharging and lubrication. The book contains 240 illustrations, of which approximately 70 are new. While it deals with the engine chiefly from the standpoint of the engineer, the operator's side is not neglected, as there are chapters on Lubrication, Starting, and Operation and Maintenance.

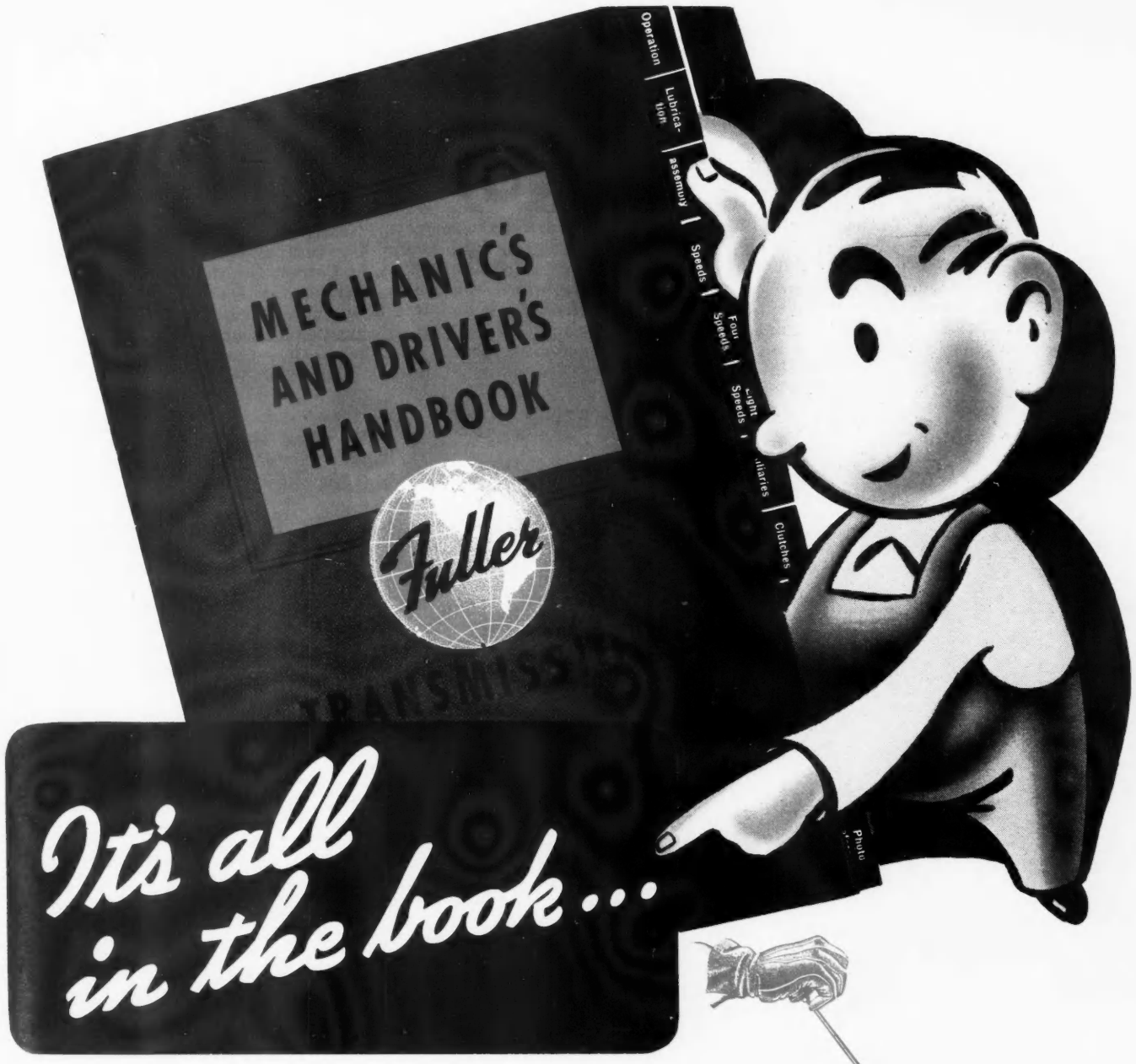
Aircraft Engine Output

(*Continued from page* 48)

last year under the Lend-Lease Administration. Since lend-lease shipments first were made to Russia in the middle of 1941, more than 3200 tanks, almost 2600 airplanes and 81,000 military vehicles have been shipped to the Soviets. Other principal recipients of lend-lease military equipment have been Egypt, India, Australia and New Zealand. Shipments of machine tools, industrial equipment and farm tools totaled $317,000,000 in 1942. Fifteen per cent of U. S. munitions production in the last six months of 1942 was furnished to other United Nations. However, about one-third of the tanks and combat planes produced in 1942 went to lend-lease recipients.

More than $550,000,000 of lend-lease funds have been spent in expanding U. S. industrial plants. Allocations for war plant expansion include $50,000,000 for the Ford tank and aircraft engine factories at Highland Park and Dearborn and $10,000,000 for the Willow Run bomber plant. Other funds went to the Chrysler Tank Arsenal, the Boeing, Douglas and Bell aircraft plants and General Motors and Sperry Corp. plants.

One of the most popular lend-lease items is the ubiquitous jeep, which has seen service in most every part of the world. Willys-Overland Motors, Inc., is one of the largest producers of this vehicle, total output of which has now



It's all in the book...

Everything you want to know about assembling or disassembling a Fuller Transmission is covered step by step and completely illustrated in this new book: "Mechanic's and Driver's Handbook."

Conveniently thumb indexed so you can turn to the section you need without stopping to look it up on a "contents page." Pocket size. No sales talk—no advertising. Just the facts you want to know. Truck service men and mechanics who are entrusted with the maintenance of Fuller Transmissions are invited to order their FREE copy from our Service Department.

FULLER MANUFACTURING COMPANY • • KALAMAZOO, MICHIGAN

reached six figures. The Army standardized on the Willys version of the jeep, using the 65-hp. Americar passenger car engine, but with lower compression. Ford also is a major producer of this vehicle.

Willys also is the largest producer of 155-mm. shells in the country. These are forged, heat treated and machined in the Willys plant at Toledo. Early in the war effort Willys offered to take on this job, although none had ever been made before outside of government arsenals. Advice from a Canadian manufacturer on shell-turning lathes helped Willys get tooled for this contract. The shell production uses up 25 tons of steel per hour. Willys also operates the second largest aluminum forge shop in the country, supplying 90 per cent of the forgings for the Willow Run bomber plant.

An ammunition hoist for Navy 5-inch guns is one of Willys' most intricate war jobs. This mechanism weighs six tons and costs $24,000. These hoists have enabled U. S. warships to compete successfully with bigger and more heavily armed enemy ships due to the higher rate of fire which the hoists make possible. Willys also is manufacturing landing gears for Grumman Navy planes, complicated center sections for Vought-Sikorsky Navy fighters, millions of bullet cores and 5-inch shell fuses.

General Motors' war production in 1942 totaled approximately $1,900,000,000, a gain of more than 360 per cent over 1941 armament output. One of the most popular GM ordnance items is the Cadillac-built M-5 light tank, which is reputed to be the fastest track vehicle in the world. This tank is being built by GM in the Cadillac plant at Detroit and the Southern California Division at Southgate, Cal. Cadillac was able to convert 70 per cent of its automotive machinery to tank production. One of the more remarkable conversions was that of an automatic wheel disc polisher. This special-purpose machine brought automobile parts against revolving buffer wheels at regularly spaced intervals.

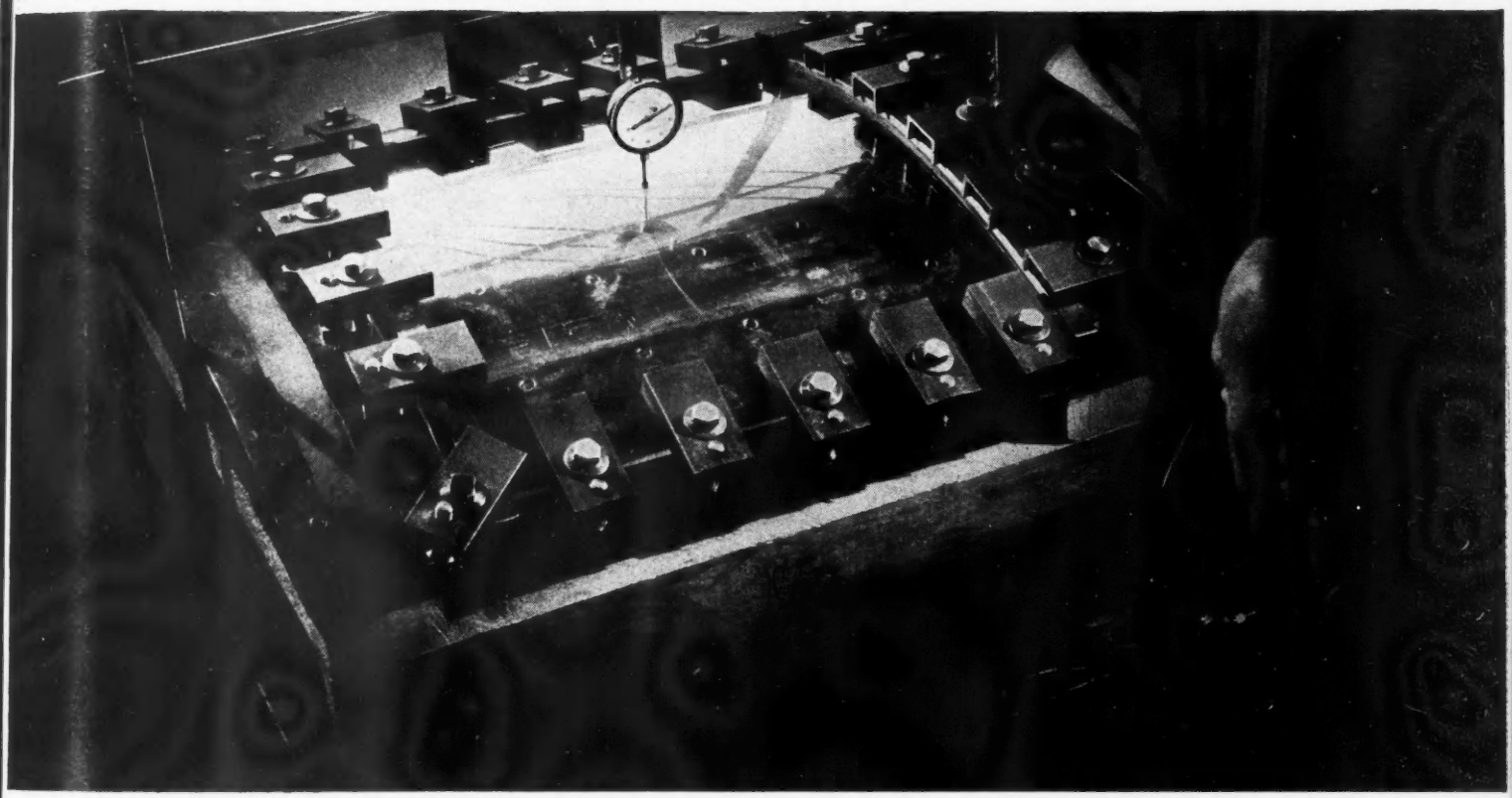
Cadillac ran into a bottleneck on finishing tank clutch plates of transfer units, each operation tying up two sets of diamond dressed hones. A tool engineer suggested trying the automobile wheel disc polishing machine. Tampico wheels were substituted for the buffers and some adjustments made so the clutch plates could be placed on the bases. The innovation was a great success, reducing clutch plate finishing time by 80 per cent and releasing valuable precision equipment for other work. It also gives the clutch plate a smoother and more accurate face.

In a recent OWI report on Detroit's war production, the following comment was made on the Ford Willow Run bomber plant: "There have been many disappointments in connection with the Willow Run operation and the plant, even now, is far from peak production. Discussions about the reasons for its long lag have been many. But bombers are being turned out and production is increasing. The most serious problem at Willow Run revolves around manpower. The plant is finding it difficult to get competent workers—and hold those they hire. The tooling job has proved to be more efficient than is generally believed—even in Detroit—and not more than half of the number of workers at first thought necessary will be required. But virtually all newcomers require training."

The press section of the Willow Run plant presents an interesting development analogous to automotive press practices. Blanking dies are used instead of a profiler for duralumin parts, a sharp contrast with standard aircraft technique. Mechanical presses and expensive metal dies are used on other parts instead of the customary hydraulic presses and rubber dies common to aircraft manufacture. Larger presses are mounted in 16-ft cast steel subbases, similar to practice at the Rouge plant, facilitating setting up the work and reducing cost of rearrangement by 75 per cent. Among the machines are four 1000-ton hydraulic presses, two Lake Erie triple action and two H. P. M. double action built especially to Ford specifications. Hydraulic equip-

(*Turn to page* 68, *please*)

The behavior of PLEXIGLAS UNDER PRESSURE



To study the behavior of curved PLEXIGLAS panels under pressure, the Rohm & Haas physics laboratory constructed the apparatus shown here. A 30" square sheet of ½" thick iron was formed to a cylindrical section with an outside radius of 32 inches. The PLEXIGLAS panels are placed between rubber gaskets and clamped to the iron plate with curved and straight iron straps 1" wide. Clamping pressure is obtained by bolting down short lever sections of channel iron. The size of free area of PLEXIGLAS subjected to pressure can be varied by using different sizes of straps. Air pressure is applied through holes in the metal plate. The deflection of the center of the panel is measured by a dial gauge.

THE design of high altitude planes and the resultant need for pressurizing cabins raises the question of the deflection of the center of PLEXIGLAS panels installed in these cabins when subject to pressure. A report containing the data assembled to date on this subject by Rohm & Haas engineers is now available.

This report, entitled *PLEXIGLAS: Deflection-Under-Pressure* recommends spherical or cylindrical shapes for all PLEXIGLAS panels to be used in pressurized cabins. It describes the effect of temperature, of clamping pressure and gasket thickness on such acrylic sections, and suggests the correct width and depth of the channels in which they are inserted. Twenty-three significant graphs supplement the text.

Write for your copy of this valuable report today, Rohm & Haas Company, Washington Square, Philadelphia, Pa.; 8990 Atlantic Blvd., South Gate, Los Angeles, Calif.; 619 Fisher Bldg., Detroit, Mich.; 930 No. Halsted St., Chicago, Ill. *Canadian Distributor*—Hobbs-Glass Ltd., Montreal, Canada.

THE CRYSTAL-CLEAR ACRYLIC PLASTICS

PLEXIGLAS

SHEETS AND RODS

★

CRYSTALITE

MOLDING POWDER

PLEXIGLAS *and* CRYSTALITE *are trade-marks, Reg. U.S. Pat. Off., for the acrylic resin thermoplastics manufactured by the Rohm & Haas Company.*

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Manufacturers of Leather and Textile Specialties and Finishes.. Enzymes.. Crystal-Clear Acrylic Plastics.. Synthetic Insecticides.. Fungicides.. and other Industrial Chemicals

(*Continued from page* 64)
ment is located beneath the floor instead of above the machine, which facilitates moving dies in and out of the presses by the overhead cranes. The hydraulic units also can be serviced without interfering with the press operation.

Ford's success with unusually deep draws on the mechanical presses with all-metal dies is responsible for elimination of many hand-forming operations. Many of the stampings for bomber doors and hatches are large and complex. Some manufacturers have used drop hammer and hand-forming processes to make these parts, with only about 20 to 30 per cent passing inspection. Ford is approaching 100 per cent through use of steel dies for this work. Only three dies are used to form the stripping and interior sections, containing the windows of the bombardier's compartment, compared to 160 dies on earlier units. Similarly, the pilot's enclosure has been reduced to two parts.

The Dodge-Chicago aircraft engine plant, which is even larger than Willow Run, has been granted an increase of $16,900,000 in its DPC contract with Chrysler Corp. This brings the total contract to approximately $173,000,000, considerably larger than the last figure announced on Willow Run.

MEN . . . . . .

Logan Monroe, formerly assistant treasurer, has been elected controller of Eaton Mfg. Co. **H. S. Ide, Jr.,** statistician, has been named assistant secretary-treasurer.

Arthur W. Herrington, board chairman of Marmon-Herrington Co., Inc., has been elected a director of the Army Ordnance Association.

Brig.-Gen. Charles D. Young (inactive), formerly assistant director, has been appointed deputy director of ODT. He will have direction and control over all matters pertaining to ODT as a claimant agency under CMP. **H. H. Kelly,** formerly assistant director and chief of the Allocation Section of the Division of Motor Transport, has been named director of the Division of Material and Equipment Requirements of ODT. He was chief of the Section of Safety in the ICC Bureau of Motor Carriers until joining ODT early in 1942.

Bayard D. Kunkle, vice president of General Motors Corp., has been elected a member of the corporation's war administration committee.

Clyde R. Paton, executive engineer for the Allison Division of General Motors, has been on special assignment as an observer in Libya.

Leslie J. Hess, formerly president, has been elected board chairman of J. C. Brill Co., succeeding **Charles J. Hardy,** who continues as chairman of the executive committee. **Ronald R. Monroe,** former vice president, will succeed Hess as president and **John E. Rovensky** has been elected a director, succeeding **William J. Harris,** resigned.

Glenn L. Martin, president of the Glenn L. Martin Co., has been elected president of the Aircraft War Production Council, East Coast, Inc., succeeding **Guy W. Vaughan,** president of Curtiss-Wright Corp. The presidency rotates among council members every three months.

B. C. Heacock, chairman of the executive committee of Caterpillar Tractor Co., has been appointed deputy director general for distribution of WPB, succeeding **J. A. Krug.**

Carl Breer, director of research for Chrysler Corp., has been elected president of the Detroit Athletic Club. **Marvin E. Coyle,** vice president of General Motors and general manager of the Chevrolet Motor Division, has been elected first vice president and **Harvey G. Fruehauf,** president of Fruehauf Trailer Co., was reelected treasurer.

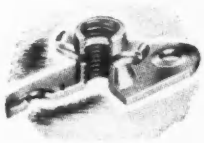
(*Turn to page* 74, *please*)

40 YEARS AGO

The Pennsylvania Automobile Club, Philadelphia, has extended several courtesies to those who participate in the run to the "Quaker City" on Washington's Birthday. Through their efforts the doors of the Union League Club will be open to them; storage accommodations for carriages have been for free of charge; the Park Department will extend the privileges of Fairmount Park without the usual permit and number required in Philadelphia; each carriage, however, must bear the initials of owners as required by New York law. They have also extended to participants the courtesies of their own club and have arranged for a run on the day of arrival on the Lancaster Turnpike to Ardmore, Bryn Mawr and West Chester, 25 miles. Owing to the heavy snow storm, the Runs and Tours Committee on Feb. 17, after consultation with those who intended to participate declared the run off.

From *The Horseless Age,* Feb. 18, 1903.

They Fly with their Boots on— a million lbs. lighter!



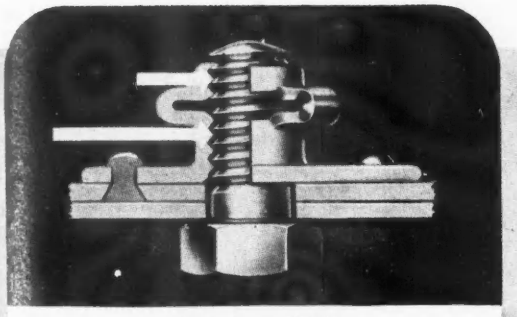
Fighter planes, bombers, cargo planes, trainers, gliders . . . all types of aircraft today "fly with their Boots on." And, because of this fact, they'll fly lighter—*by a million pounds.* For Boots Self-Locking Nuts—the important anchor and channel types—are stamped from sheet metal.

Besides making America's planes a million pounds lighter, they *save* a million pounds in strategic metals.

Government authorized, self-locking nuts . . . all-metal . . . "lighter and everlasting". . . therefore better in operation and maintenance.

Today engine manufacturers are making extensive use of another Boots item—the "Rol-Top," all-metal nut.

All of which means that we have *better* planes, and *lighter* planes . . . with less consumption of metal, when they fly with their Boots on.



HOW IT WORKS

The Boots Self-Locking Nut is one-piece, all-metal—withstands severest vibration. The top (locking) section is displaced in a downward direction . . . locking threads are out of lead with load carrying threads of lower section.

Upon insertion of bolt, top section of nut is extended to engage with threads of bolt. A constant force is thus established which locks nut firmly into position. Axial thread play is eliminated.

BOOTS

Boots Aircraft Nut Corporation

Self-Locking Nuts for Application in All Industries

GENERAL OFFICES: NEW CANAAN, CONNECTICUT

New Products for Aircraft

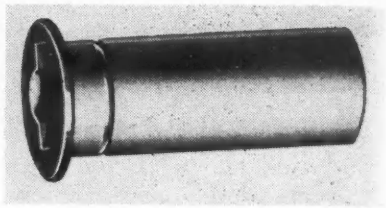
(*Continued from page 43*)

shape of the finished work. A cutter head and its follower are part of the same assembly. As a follower moves over the template, held in close contact by pneumatic pressure, the cutter of the assembly moves in the same direction through the work.

The bed, on which the carriage rides, consists of one or more cast iron sections. These sections come in 7½ ft and 15 ft lengths, any combination of which may be bolted together to secure as long a bed as necessary.

Anchor Nut and Rivet

Dill Lok-Skrus, made by The Dill Manufacturing Co., Cleveland, Ohio, are used by airplane manufacturers for anchor nuts and for metal to metal riveting. They require only one drilled hole, and mounting is a one-man operation with either hand or power tool. A few of the applicatins are the attachment of exhaust tail pipe fairing and shielding, window frames, de-icer boots wing tips, door frames and interior plywood panels.



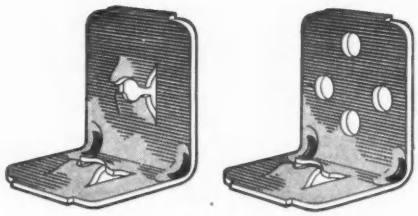
Dill Lok-Skru

Aero Quality Lumarith

Celanese Celluloid Corporation, New York, N. Y., is employing a special formula in making their Aero Quality Lumarith transparent aircraft plastic, which is said to screen out all severe sunburn producing ultra-violet rays. It is reported that on long bombing flights at high altitudes behind some types of plastic windows, aviators have returned severely burned. The makers state that painful or harmful sunburn will be greatly minimized behind windows of Aero Quality Lumarith.

Angle Bracket and Fastener

Tinnerman Products, Inc., Cleveland, Ohio, are making a line of angle brackets which feature an integrally formed Speed Nut in one or both sides of the bracket, according to the application need. They are made for 8Z and 10Z Air Corps sheet metal screws and standard rivets. When used in connection with conduit and piping, this bracket permits the use of standard bonding clamps in place of ear-type aluminum bonding clamps. The device is said to shorten assembly time and save weight in aircraft and other war equipment.



Combination Bracket and Fastener of Tinnerman Products, Inc.

A Universal Hose Line

Aeroquip hose lines have removable fittings which can be re-used repeatedly. The hose can be cut to any length, and fittings installed by means of an assembly tool which guides the nipple into the hose, after the hose has been screwed into the socket. According to the makers, the Aeroquip Corporation, Jackson, Mich., the design of the hose is such that it can be used at temperatures of —22 deg F to +300 deg F

Flood casualty YESTERDAY

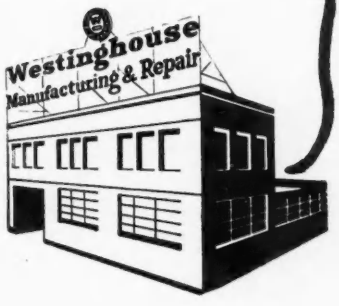
OK'd for Service on the Production Front Today

FLASH FLOODS "SOMEWHERE IN U.S.A." 48 TONS OF ELECTRICAL EQUIPMENT WATER-SOAKED, UNFIT FOR SERVICE. RUSHED TO WESTINGHOUSE MANUFACTURING & REPAIR PLANTS, DRIED IN ELECTRIC OVENS, RECONDITIONED, INSPECTED, TESTED...WITHIN 24 HOURS MANY OK'd MOTORS WERE ON THE RETURN TRIP—WITHIN 10 DAYS ALL EQUIPMENT RESTORED TO SERVICE.

Westinghouse
MANUFACTURING AND REPAIR

J-90462

IF **THE EQUIPMENT NEEDING REPAIR IS VITAL TO THE WAR EFFORT . . . PHONE THE NEAREST OFFICE OF WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY FOR**



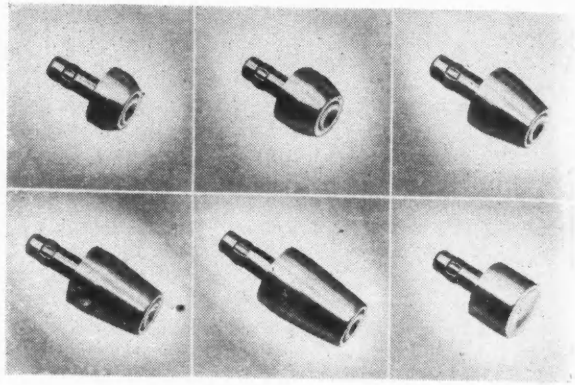
EMERGENCY SERVICE

33 M & R PLANTS . . . ONE NEAR YOU!

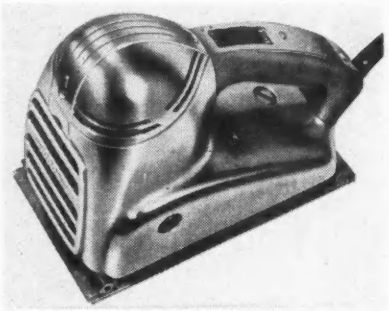
in connection with all fluids used in airplanes, for example, gasoline, mineral or vegetable oil, hydraulic fluid, alcohol, fire extinguishing medium, de-icing fluid, water, and glycol. Aeroquip hose lines are said to withstand severe operating conditions, from vacuum up to pressures of 2200 psi.

Aeroquip Hose Line

Among the tools added to their line by Aircraft Tools, Inc., are rivet squeezer sets made of National Emergency steel. They are available for all standard size round and brazier head rivets, as well as flush riveting operations, and may be used with either hand or pneumatic squeezers.



THE Sterling 1000 electric sander, made by the Sterling Tool Products Company, Chicago, Ill., is powered by a 1/5 hp. fan-cooled universal motor which is protected from dust by a replaceable filter screen. Gears and counter-poise mechanism are sealed in a dust-proof cartridge type gear case.



Sterling 1000 Electric Sander

Only one bronze bearing is used, the others being ball or needle bearing type. A quickly detachable sanding pad, operated by a latch type lock, takes 1/3 sheet of standard abrasive, and is made flexible to permit sanding on curved or flat surfaces.

MEN

(*Continued from page 68*)

J. F. Weller, president of the Kellogg Division, has been appointed director of automotive sales of American Brake Shoe & Foundry Co.

Otto Z. Klopsch, general manager of the Wolverine Tube Division, has been elected a vice president and director of Calumet & Hecla Copper Co.

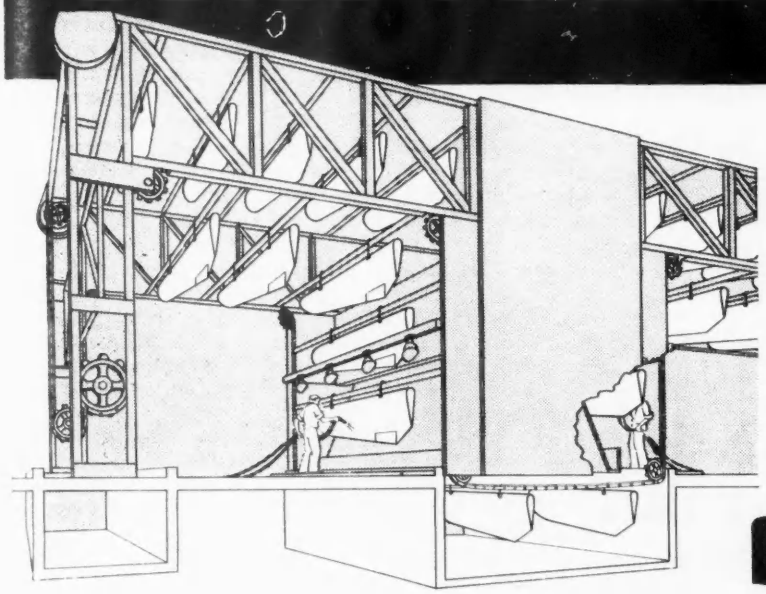
Edwin O. Jones, sales manager of the original equipment division, has been elected vice president of Federal-Mogul Corp. **Guy S. Peppiatt** has been named executive assistant to the president.

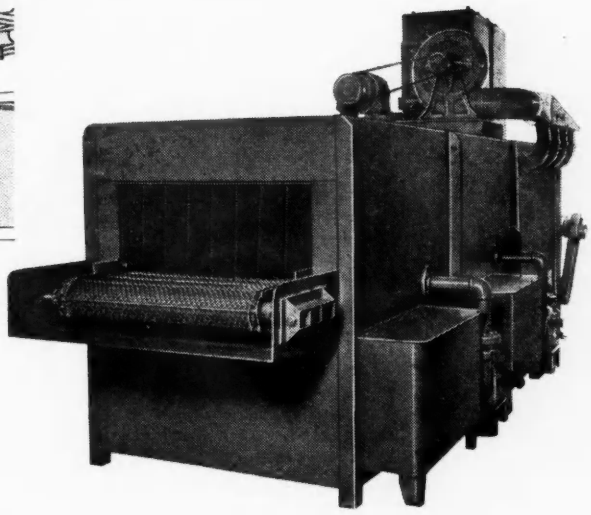
Brace H. Sibley has been appointed factory manager of the Champion Spark Plug Co. **C. E. Dewar,** formerly vicepresident in charge of production, has retired after 28 years with the company. **B. O. Black** has been placed in charge of production planning and control. **John Nolan** has been made production engineer and **J. H. Beatty** supervisor of employee relations.

William J. Mougey, advertising manager of the Pontiac Motor Division, has been transferred to the Washington office of General Motors Corp.

F. L. Hopkinson, vice president, has been elected a director of Willys-Overland Motors, Inc.

2 WAYS to BUILD PLANES FASTER





WITH the cooperation of Fleetwings, Inc., engineering staff, Alvey-Ferguson engineers designed and built this A-F "endless stream", overhead conveyor system which moves parts at exactly the right speed for continuous processing at high efficiency. Unused ceiling space was used to boost production without increasing floor space. . . . Other types of A-F Conveying Equipment have helped other airplane manufacturers produce planes faster and thus bring the day of Allied Victory nearer.

★ For Consolidated Aircraft, this A-F equipment for high-speed cleaning, rinsing and drying miscellaneous airplane castings was produced. With 36 in. wire mesh conveyor, this A-F equipment cleans and dries all types of castings up to 17 x 36 inches in size.

Without obligation on your part, write, wire or telephone regarding your problems of "indoor transportation" of war products and materials, or cleaning or finishing of metal products.

THE ALVEY-FERGUSON COMPANY

20 Disney Street, Cincinnati, Ohio

CONVEYING EQUIPMENT

CONVEYING A F MACHINERY

Alvey-Ferguson

METAL PRODUCTS CLEANING & FINISHING EQUIPMENT

Interchangeability of Parts Is Next Objective

(*Continued from page* 17)

truck manufacturers. In 1939 such production amounted to less than 15,000 vehicles and even with added Army contracts, in 1941 it numbered less than 30,000 units. This contrasts with several hundred thousand vehicles in the lighter tonnage groups. Among the producers of this heavy duty equipment are Autocar, Diamond T, Federal, Mack, Reo, White, and Corbitt.

When the Army truck manufacturing program was in full swing, there was little time for standardization and simplification. Trucks were needed immediately so the producers called on all the sources of supply available in order to fill the Army contracts. Thus, heavy trucks of the same general type, such as wreckers or pontoon carriers, might have a variety of engines as Hercules, Continental, Lycoming, Cummins, Waukesha and Buda were called upon to make power plants for the mechanized and motorized divisions that were being organized by the U. S. Army. This emphasis on speed in production has made for a heterogeneous situation as regards the replacement parts that must be supplied. It's rather difficult to remedy the situation for trucks already operating in distant war theaters other than to attempt to ship the same makes of trucks to a single combat zone. Yet lack of parts may immobilize a vitally needed water purification unit or a tank truck.

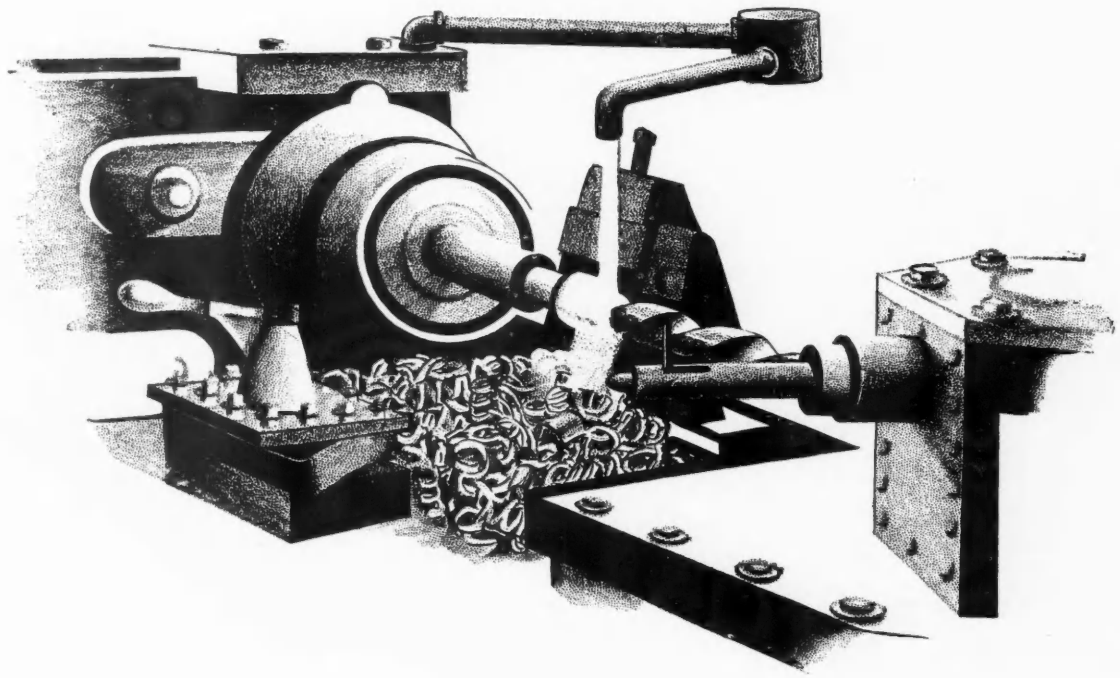
Some simplification has been obtained in the combat vehicle group. Three manufacturers, White, Diamond T and Autocar, are producing identical models of the half-trac armored car. A centralized purchasing system has enabled them to standardize on parts and greatly simplify the maintenance procedure. In the M14 medium tank, four engine types are used with a consequent involved parts and maintenance problem. Chrysler, Continental, Ford and General Motors Diesel all were called upon to supply engines for the huge medium tank program. Now with tank production leveled off at December rates and the initial supply problem overcome, the Tank-Automotive Center is endeavoring to standardize on a single medium tank engine, although for strategic reasons it is possible that the Army will continue to order more than one type. The replacement parts problem in medium tank maintenance has been somewhat alleviated by assigning tanks with one type of engine to a single theater of war. Thus, the first medium tanks shipped to Libya all were powered with Wright Whirlwind radial engines built by Continental. Tanks shipped to another war theater might have a different power plant.

The value of simplification and standardization is illustrated by the fact that war materials are being shipped to 43 theaters of war. With some shipments inevitably lost through enemy action on the high seas, it is much better if a fewer number of parts types have to be shipped to any one destination. As an example, a shipment of 100 ¾-ton Army vehicles requires 34,000 spare parts to accompany it weighing 20 tons and shipped in 249 scientifically designed boxes to make the utmost utilization of shipping space. Most of the parts for these vehicles are interchangeable, although there may be some differences among the six standard Army body types that go on the ¾-ton chassis. This first shipment of parts must be followed by another six months later.

When it is considered that every division going overseas takes more than 2000 motor vehicles, while an armored division numbers more than 3000 units of motorized equipment, the problem of the Services of Supply and the Ordnance Dept. is rather staggering. Where there is a diversity of vehicle types and special equipment, the spare parts supply and maintenance problem is just that much more complex.

In the Development Branch of the Tank-Automotive

Keep The STUTTER Out of Your CUTTER



. . . Best bet is to check your cutting fluid. For while there are many machining operations, there can be only one *correct* cutting oil for your particular job. That's the coolant that delivers the "tops" in speed, finish, and tool life.

The difference between a "top" lubricant and one of ordinary quality means much these days of high speed, precision production. Particularly because many manufacturers are working many different types of materials, each presenting a new cutting oil problem. Cities Service Chillo Cutting Oils and Cities Service lubrication engineers have solved many of these problems and are continuing to do so daily. Why not find out what this combination will do for you? A consultation will cost you nothing. A copy of a new booklet, on "Metal Cutting Lubrication," will be sent free to users of cutting oils.

Just drop us a line or get in touch with the nearest Cities Service office. There is no obligation, of course!

CITIES SERVICE OIL COMPANY
NEW YORK • CHICAGO

IN THE SOUTH
ARKANSAS FUEL OIL COMPANY
SHREVEPORT, LA.

Center at Detroit has been set up a Simplification Section, headed by Lieut.-Col. Frank A. Mickle, former associate professor of mechanical engineering at the University of Michigan. He is assisted by Charles W. Kynoch, chief engineer of the branch, with an extensive background in Army motor transport work. The new section will need the close cooperation of the various using arms and services of the Army as well as the help of the vehicle manufacturers. It will be abetted in this liaison work with industry by two civilian aides—Austin M. Wolf, New York transportation consultant and chairman of the Transportation and Maintenance Activity of the SAE, and M. C. Horine, of the Mack Mfg. Corp.

The Section, only recently activated by the Tank-Automotive Center, is making ready to compile complete mechanical data on all vehicles and their components to determine where simplification can be accomplished. Efforts will be made to eliminate from the series of combat and transport vehicles all duplications and variations in basic types, sizes and components.

It is hoped to set up a workshop at Detroit where units of current production vehicles can be brought for close scrutiny and study by Ordnance Dept. and automotive engineers with a view to increasing the interchangeability of parts. If parts changes are made, the effect upon the performance of the vehicle also must be considered. When standardization is possible on any parts, the manufacturers must be consulted to see that the changes will not upset production schedules unduly or disturb reliable sources of supply.

The Simplification Section will endeavor to maintain up-to-date specifications and bills of material on all combat and transport vehicles in production so that standardization and simplification will be expedited. Thus, any manufacturing changes affecting spare parts would have to clear through the section in order to preserve the simplification program. The men in charge of the section are not under any illusions about the immense task that confronts them. They do not expect any overnight changes that would revolutionize the military vehicle procurement and replacement parts programs. They are not trying to move mountains. But they do believe that any step that will simplify the replacement and maintenance problems of the Army's combat and transport vehicles will be a step in the right direction—towards winning the war.

Aeronautical Engineers Study Developments

(*Continued from page* 42)

namic loads encountered by aircraft structures under service conditions revealed that dynamic loads whose magnitudes exceed present static requirements are encountered on nose wheel struts.

Among the aerodynamics problems discussed at the meeting were torsional aileron flutter, maneuverability criteria, and the compressibility effects on high-speed airplanes. K. D. Wood of Purdue University submitted two aspect-ratio-correction formulas for the lift-slope curve to replace customary calculations which are said to be in error by as much as 30 per cent for aspect ratios of 1.5 or less. The Wood empirical equations follow:

$$m = \frac{2\pi A}{A + 2.7} \quad \text{(for elliptical tips)}$$

$$m = \frac{2\pi A}{A + 3} \quad \text{(for rectangular tips)}$$

where m is the correction factor and A the aspect ratio.

Roland J. White, an engineer at the St. Louis plant of the Curtiss-Wright Corp., outlined a new method of longitudinal control, which would permit of an airplane being flown with safety when the useful load is concentrated in either an extreme forward or the extreme rearward position. Two additional horizontal surfaces would be required, each attached to the present type elevator, and would be controlled by the pilot to regulate the stability to suit a particular flight condition.

. . . THE NORTON TYPE C SEMI-AUTOMATIC

ON the 1943 production front, will your grinding machines give comfortable continuous operation for your semi-skilled help?

The Norton Type C Semi-Automatic is designed with finger-tip control for ease of fast, uninterrupted operation; with ready, accessible adjustments for dimensional accuracy and precision finishes.

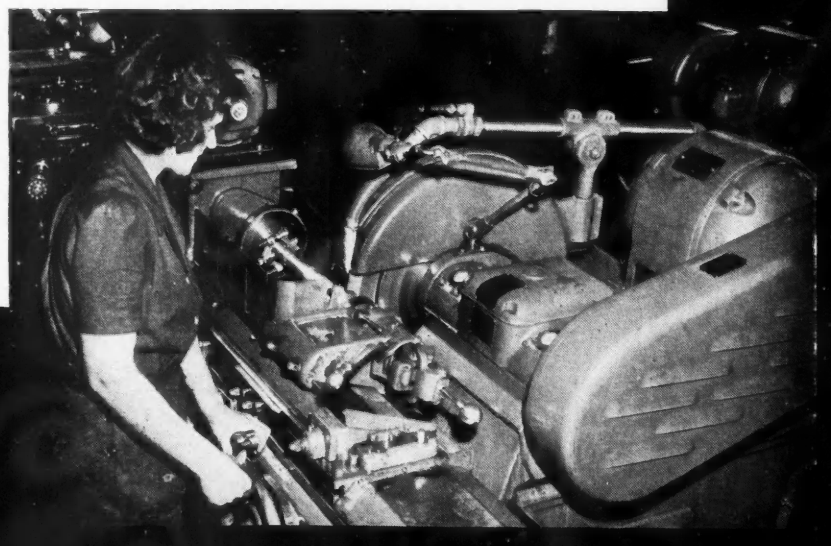
Norton machines supplement quick-taught skills. Semi-automatic operation with either manual or electric cycle control removes the mental hazard of spoiled work, assures accurate dimensions. Simple adjustments regulate grinding feeds and speeds, compensate for wheel wear in truing.

Automatic start-stop of headstock and hydraulic control of footstock and steadyrests, available extras, provide further simplification of operator controls.

If you promise yourself all-out production in 1943, give your home-front recruits the Norton Type C Semi-Automatic grinder, the machine combining ease of operation with precision production.

NORTON COMPANY
Worcester, Mass.
New York **Chicago**
Detroit **Cleveland**
Hartford

M-451



NORTON
GRINDING MACHINES

Employment of Women May Help Labor Shortage

(Continued from page 54)

tion despite the claim of dependents. However, the net gain to Detroit war plants from this source is only estimated at 20,000 workers.

Another 100,000 workers are expected to migrate into the city to fill the remaining war jobs. Although housing and transportation facilities already are critical, it is now expected that these in-migrants will be needed to man the war plants. However, this total need may decrease with changes in the strategic situation and improved plant efficiency. The U. S. Employment Service has discouraged in-migration until all local sources of labor can be absorbed.

The job stabilization order that went into effect in the Detroit area Dec. 10 and which has now been put into effect by WMC in 32 areas where the labor situation is critical has drastically reduced labor turnover and stopped "pirating" of skilled labor. This problem had been particularly acute in outlying plants like the Willow Run bomber plant, which hired 3900 workers in November and lost 2100, a number of the latter to the armed forces. Lack of housing facilities near the plant and the long distances that must be traveled by many workers to reach it have aggravated the situation as far as this one factory is concerned. It is located 25 miles from downtown Detroit although somewhat closer to Dearborn, Ypsilanti and Wayne.

The U. S. Employment Service has a nation-wide drive under way to recruit workers for 25 special skills in which there is an acute shortage. These jobs which automotive plants are in need of include airplane skin men, airplane subassemblers, metal work bench hands, cylindrical grinder operators, flanging press operators, internal precision grinders, metal chippers, milling machine operators, tack welders and automatic and semi-automatic screw machine operators.

The labor unrest in Michigan has quieted somewhat since the establishment of a regional War Labor Board at Detroit and the appointment of Prof. Edwin E. Witte, chairman of the economics dept. at the University of Wisconsin and author of the nation's first unemployment compensation law in Wisconsin, as chairman of the Detroit board. The Detroit office took over jurisdiction in 650 voluntary wage agreements requiring WLB approval. These formerly were delayed by having to be routed through the Cleveland and regional office of WLB. Seattle also has been set up as a separate WLB regional center, along with the nation's 10 original centers. The regional boards have been delegated more authority to settle labor disputes in order to relieve the National board in Washington.

G. Allen Dash, umpire under the General Motors-UAW-CIO contract, ordered reinstatement of B. E. Gangl, president of Chevrolet Forge Local 262, after he had been fired by Chevrolet for participation in a one-day wildcat strike which was precipitated by his refusal to work on his steam hammer job due to dissatisfaction with the piecework rates. However, Gangl was given a 30-day suspension from his job. Discharge of another worker who incited the strike was upheld by Dash, along with suspension of three other strike leaders for periods from 60 to 14 days. Ford Local 600 of the UAW-CIO has appointed Harry Ross as administrator of the local maintenance unit as the aftermath of an unauthorized strike at the Ford Rouge plant Jan. 5 which made 11,000 employes idle. The unit officers and nine building committeemen resigned after the strike, which was in protest of a company proposal that had been approved by the union.

Chrysler Corp. has been granted permission by WLB to raise its 12,500 salaried employes 6½ per cent, which will amount to $1,500,000 annually. The increase is 2 per cent monthly more than the raise granted to hourly workers last Fall in a case before WLB. Packard Motor Car Co. also has been given permission to raise its salaried employes.

Unfair to Gremlins!

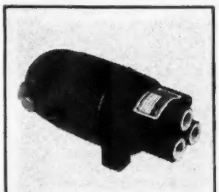
NO HAPPY HUNTING GROUND for Gremlins in these ADEL-equipped fighting planes serving the United Nations' Air Forces. These pesky little sprites who, as everyone knows, are responsible for faulty flying, find ADEL aircraft equipment just about Gremlin-proof.

ADEL hydraulic control valves never jam in spite of Gremlins.

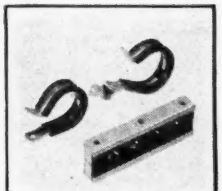
ADEL clips and blocks protecting vital life lines against vibration remain clean and strong, refusing to transmit Gremlin static howls.

ADEL anti-icing pumps insure ice-free carburetors, propellers and windshields in all altitudes and weather.

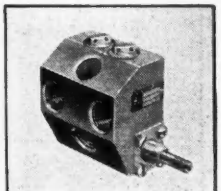
The secret of foiling Gremlins? *Design Simplicity* plus *maximum standardization*. For complete information contact nearest engineering service office.



ADEL Series "J" Pump—veteran of *six* winters of anti-icing protection for carburetors, windshields, propellers.



ADEL dual-purpose line support clips and blocks. Thousands of *standardized* types; millions in service thruout the globe.



ADEL "Mighty Midget" 4-way hydraulic selector valve. 72% smaller, 76% lighter in weight than previous units.

ADEL

PRECISION PRODUCTS CORP., BURBANK, CALIFORNIA

Engineering Service Offices: DALLAS, TEXAS • DETROIT, MICH. • HUNTINGTON, W. VA. • HAGERSTOWN, MD. • TORONTO, CANADA

Vega's Material Conservation

(*Continued from page* 37)

Break for the Enemy." Next to each tool is its name, its cost, and the misuse which broke it. Examples: "This drill was used at too high a speed—cost $9.60." "This milling cutter was used for too deep a cut—cost $18.97." "This wooden mallet handle was used to back up a drilling operation; this is the kind of thoughtlessness that helps Hirohito."

Another exhibit board shows fabricated sheet metal parts that have been spoiled by poor workmanship. A red pencil mark shows the reason for its rejection by the inspector.

Information was supplied the education department for an experiment. A fabrication group was divided into zones and a large chart was erected to show the number of rejections for each thousand man-hours of work. In this way, the competitive spirit is used to get results. Rejections have fallen off remarkably.

Educational material is also supplied to supervisory training courses, and to classes held for new employes. Meetings are arranged periodically with foremen and group leaders to show them the newest methods of combatting waste. Another effective method is to have foremen of certain departments visit the salvage dumps and see for themselves the amount of usable material that has been swept up from their floors.

Special Projects

The second phase of the program consists of the investigation of specific material wastes and their correction by changing poor shop practices, material substitutions, better controls, or new methods. The work is done by the project, that is, as a problem arises it is assigned to a material conservation analyst, who follows it through to its completion.

Projects start from a variety of sources. They may come from design engineering, production engineering, tool design or anywhere in the shop, from fabrication, sub-assembly, or final assembly. The group has "sold" conservation to the shop and, as a result, calls come in constantly from foremen requesting investigations. Each foreman knows that his record depends upon the efficiency of his department, and thus takes advantage of this service offered.

A weekly scrap report is published by another group showing the number of parts made in each department and the number of parts spoiled. A ratio between these two figures shows the "batting average" of each section. Thus, when week to week comparisons are made, opportunities for investigation of material waste show up. In the course of one investigation, analysts often encounter related problems and the group now has a backlog of work which will require many months to complete.

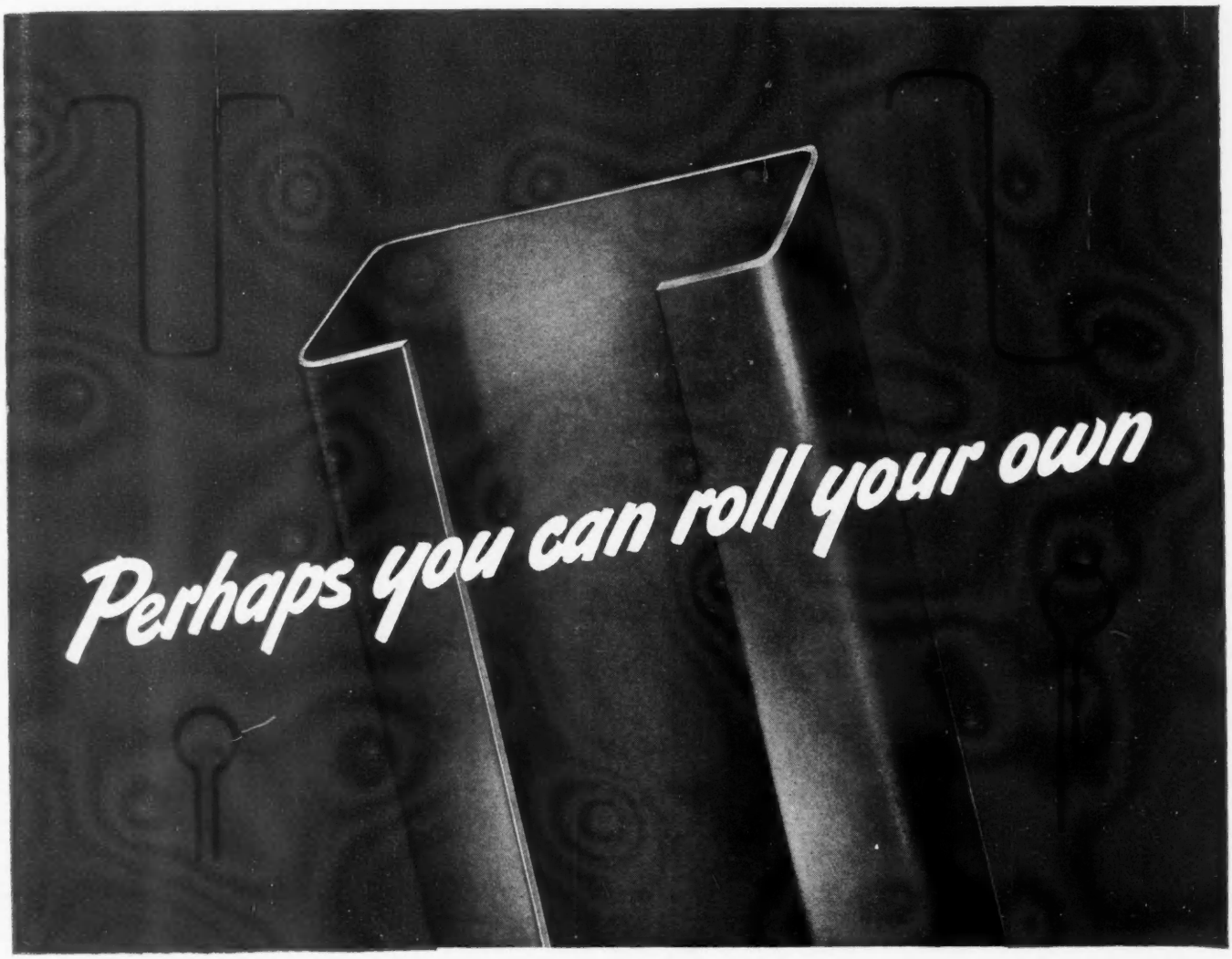
Very often, while investigating a case of material waste, it is found that a change of tooling, a modification of fabrication method, redesigning a part for better "nesting," or a change in operation sequence would save material. So while the conservation analyst starts his investigation primarily to save material, his work involves many phases of production engineering and he is thoroughly trained to handle these problems.

In general, this is the way that each project is handled:

1. The project is assigned to an investigator.
2. He makes a survey, analyzes the problem, writes a report, and suggests methods of correction.
3. The proper authorization from management is obtained.
4. The new plan is put into effect.
5. The system is followed up after an interval of time to make sure that it is operating as intended and corrections in procedure are made as needed.

Specific examples

Engineering changes that have been made in parts fabricated from sheet



This shape is rolled from Alcoa Aluminum Alloy sheet in a single operation. Its use may take the place of a thicker extruded shape, thereby releasing metal and extrusion presses for production of vital war materials. Its producer is one of many companies who are roll-forming similar aluminum-sheet shapes.

Many of these rolled-sheet shapes, being produced today for war products, are made of heat-treated aluminum alloys to give them high strength. Often, the "as-rolled temper" strip is fed right from the heat-treating furnace to the forming rolls, before the metal can age-harden, thus avoiding distortion that might occur if heat treatment followed forming.

Also shown above, in silhouette, are other rolled-sheet shapes. It doesn't take much stretching of the imagination to visualize a great variety of these aluminum shapes used in numerous products. Exactly the right thickness and shape for strength and stiffness, but no more metal than is actually needed.

The economies possible with large quantity production are certain to cause these aluminum rolled-sheet shapes to be adopted widely for all kinds of postwar applications. ALUMINUM COMPANY OF AMERICA, 2110 Gulf Building, Pittsburgh, Pennsylvania.

ALCOA ALUMINUM

stock such as aluminum, stainless steel, and insulation board, have upset the previous layouts which nested the parts for maximum economy. In some cases, the sizes of sheet stock planned on were unobtainable and a different size was accepted rather than permit a delay. Development of pre-planned layouts has saved material and labor. The redesigning of parts to fit smaller stock sizes has resulted in better nesting.

Originally, in order not to hamper production, certain non-productive supplies such as tape, gloves, saws, string, "cleco" fasteners, brushes, rags, flashlight batteries and paper were issued upon anyone's request. In small organizations this worked very well, but with thousands of factory workers involved, new and stricter methods of control have been necessary.

One analyst was assigned to investigate saws—bandsaws, power and hand hacksaws. He wrote a report showing the average monthly consumption of each type, the departments using them and the relative costs of re-filable, non-filable, and blades that could be re-set. It was found that sometimes the blades were used with incorrect feeds, or that they were not turned in for re-sharpening soon enough, thus spoiling them. A new system of disbursement and follow-up was suggested. The man who operated the saw sharpener was put in charge and the records show a substantial monthly saving.

6500 gloves had been distributed in one month. Analysis showed that cotton, leather-palmed, and all leather types were being used. Women were using gloves which were too large for them. A test campaign was conducted to see which type glove was best for each occupation. Now the gloves are disbursed on these findings and a system of washing, dry cleaning, and repairing is being used.

Flashlight battery consumption had gone up. It was found that the scarcity of extension lights and the practice of throwing away two or three cells if one alone was weak proved to be the reason. Today an unique testing device is used, placing those cells back in stock which still have several hours of light left. One out of every three batteries thrown away is now saved.

Specially trained men, in close contact with engineering, continually make investigations which result in the substitutions such as plastics for metals, low carbon for stainless steels, and other low cost, readily available materials for those which are under priority. Trim stock is used to make smaller parts such as washers, and shim stock, through the use of open dies.

New methods or improvements of old methods are being constantly adopted. Formerly, to obtain a quantity of rings, a bar was drilled out, wasting the interior portion. Now the bar is cored out by a special tool, saving the interior portion in the form of a smaller bar. Many parts which had been planned for drop hammer and hydro-press forming, are now being turned out faster and cheaper with punch presses.

Another study resulted not only in saving material, but in eliminating several operations formerly performed on window glass. Originally the glass came wrapped in paper and had to be covered and uncovered several times for receiving inspection, installation, painting, and field servicing. The manufacturer now covers the glass with a transparent plastic stripping coat and this stays on until just before delivery. This permits inspection, prevents scratching, and saves masking paper, the labor involved in masking and unmasking operations. The coating is easily stripped off when desired.

Equipment to help factory workers save material: Aprons with four small pockets to hold rivets, rivet trays which fasten to jigs by hooks and suction pumps, and a tape dispenser. This consists of a locked wooden tool box, in which many rolls of different width tape are mounted on a spindle. The tape is drawn out through slits in the side of the box and a knife edge facilitates cutting.

New Job Created

Vega has created a new job—The Material Conservation Analyst. All these

Air Power Through Piston Rings

McQUAY-NORRIS
ALTINIZED
PISTON RINGS

PARTS FOR AIRCRAFT ENGINES
Piston Rings
Oil Sealing Rings
Supercharger Rings
Carburetor Parts
Machined Aluminum Pistons
Piston Pins
Counterweight Cheek Pins
Machined Magnesium Parts
Cylinder Hold Down Nuts
Hardened and Ground Parts

PARTS FOR PROPELLER ASSEMBLY
Machined Magnesium Parts
Piston Rings

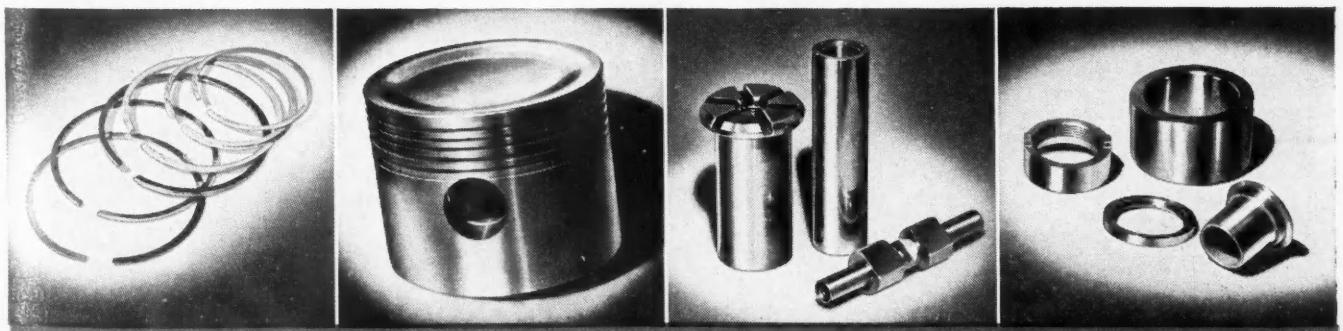
EQUIPMENT FOR MAINTENANCE OF AIRCRAFT
Pistons for Oxygen Compressor
Piston Rings for Oxygen Compressor
Pins for Oxygen Compressor
Pistons for Air Compressor
Pins for Air Compressor
Piston Rings for Air Compressor

LANDING GEAR PARTS
Machined Aluminum Pistons
Piston Rings
Hardened and Ground Parts

PISTONS . . . PINS . . . HARDENED AND GROUND PARTS

War demands new and higher standards of performance and stamina in aviation parts. At home and on every front, McQuay-Norris parts are measuring up to these increased demands. Through our clinical research, our engineering and technical experience, we are constantly expanding our services to the aviation industry. We are now direct contractors to the Army and Navy and sub-contractors on precision parts for aircraft, tanks, scout cars and trucks. We believe our 33 years' experience in precision manufacture may help you. Your inquiries are invited.

PRECISION WORKERS IN IRON, STEEL, ALUMINUM, BRONZE, MAGNESIUM



McQUAY-NORRIS MFG. CO. (AIRCRAFT DIVISION), ST. LOUIS, U.S.A.
CANADIAN PLANT, TORONTO, ONTARIO

men have engineering training or the equivalent in broad shop experience, and they must possess the kind of personality that can sell a new idea both to a factory worker and a plant manager. The beginner spends several weeks circulating around the plant working under the direction of more experienced men. In this way he gains experience in the various fabrication and assembly departments before he is assigned to one area. The men become specialists in their field and get to know the workers in their section. In this way confidence is built up so that they are consulted for help when problems arise.

These analysts are trained to be observant and to catch wasteful practices that the average person would overlook. When material or labor is being wasted, the most important factor is the analyst attitude, which is, "Can we all work together to correct this problem?"—an attitude of cooperation. They know that they cannot impose conservation from above, but that they can get wholehearted support by continually selling their program.

Management has given the Material Conservation Group a free hand. The soundness of working on this basis has been proved by the actual saving of $12 for every man-hour of time spent by the analysts.

Stromberg Carburetor Production

(*Continued from page* 22)

above would be quite ready for shipment. But actually there is more to the procedure than that. The accepted units now are routed to another large department which is termed the "Wiring" line. This consists of a large group of gravity roller conveyor stations, fitted with work-holding fixtures and special tools for handling the details of "wiring" and "oiling." Wiring of the Bendix carburetor is a very important "locking" operation in which the many critical adjustments and component parts are rigidly secured against the heavy vibrations of the engine in actual service. Generally speaking, a single carburetor requires from 35 to 66 individual wires of varying lengths and gage, entails a major expenditure of man-hours.

Fatigue of Metals

(*Continued from page* 31)

Reuleaux formula intersect at 300,000 or 400,000 stress cycles, an impossible condition by the proposed theory, because the materials were identical.

The Wahl formula curves intersect in the region of high stress, as is required by the theory. The difference in slope of the two Wahl curves is interpreted as differences in stress concentration or in stress range for these two groups of springs. The fact that these data show greater stress concentration or greater stress range for the springs having the greater index requires explanation, but the data at hand are insufficient to permit more complete analyses.

The numerical value of stress in these springs as shown in the chart is not now important, for reasons that have been discussed, nor should it be assumed that the Wahl formula will suffice when adequate data have been studied.

The subject of these springs is introduced to show that the accuracy of practical stress formulas for any machine element can be analyzed, no matter how complex the stress pattern, if given the necessary fatigue data. This already has been done for a number of machine parts, and sufficient fatigue tests have been made on other parts to construct significant stress formulas if they can be assembled for study.

It is realized that the discussions given the several subjects introduced in this paper are inadequate and incomplete. They are inadequate because of limitations of space, and they are incomplete because of meagerness of data. It is hoped, however, that enough has been said to indicate some of the shortcomings of our present procedures.

Will Your "FORTRESS" Be Ready On Time?

Think of the months of training and practice this bomber crew put in before they were ready for the real test.

ALTER EGO: And, think of the *years* of effort engineers and shop men put into the development of the "Flying Fortress" . . . all to enable the crew to rule the airways—to navigate in a bee-line to the destination, fight off "competition" all the way, hit the target and get home safely.

Like the YEARS of preparation that'll be required to develop fortresses of knowledge before business crews can expect to rule the post-war market ways.

ALTER EGO: Right! It'll take shrewd management to steer a course of profits . . . ingenious designing to fight off tough competition . . . efficient production to hit the mark of rock-bottom costs and top quality. All of this *to survive.*

All of which is embodied in the practiced use of arc welding. There's our fortress for survival in the Battle for Business. Let's start developing our welding knowledge NOW by consulting Lincoln.

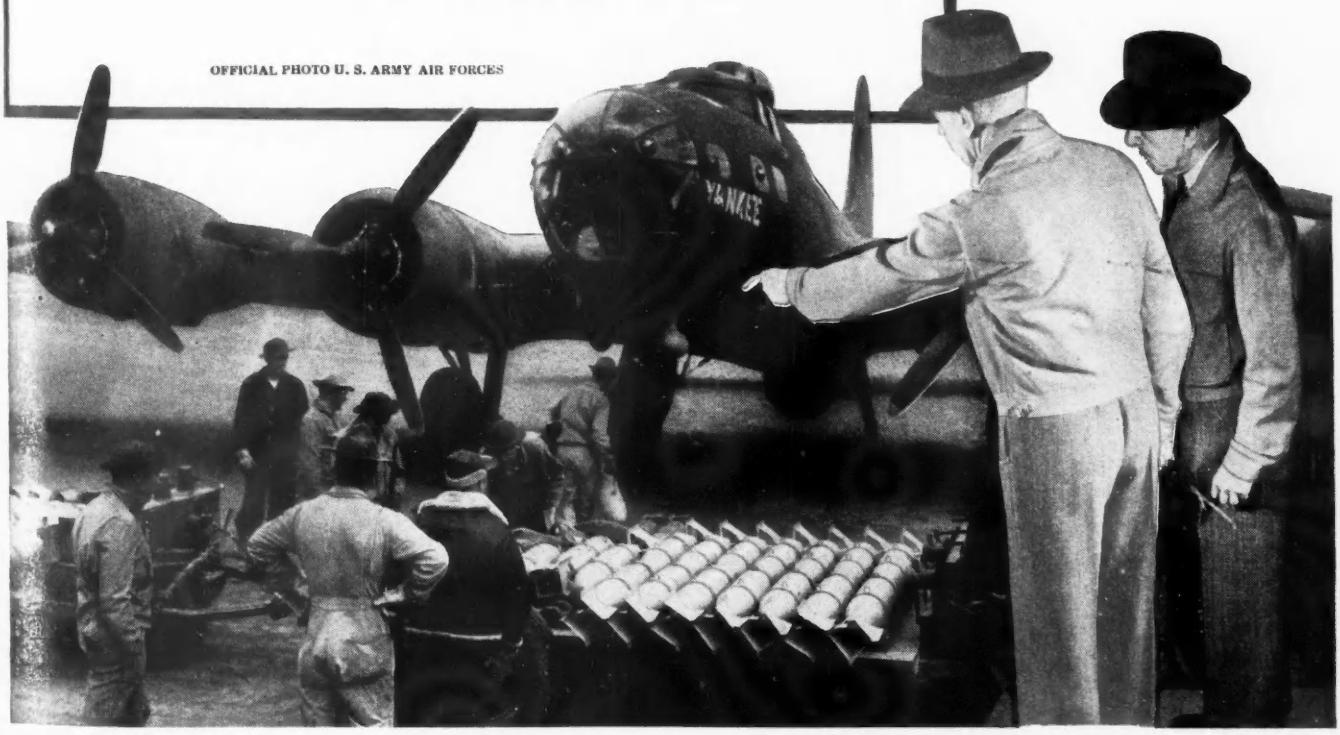
Ask your inner self if time isn't getting short for post-war planning

THE LINCOLN ELECTRIC COMPANY
CLEVELAND, OHIO

then I said to myself—

WELDED PRODUCTS HIT THE TARGET

OFFICIAL PHOTO U. S. ARMY AIR FORCES



New Apparatus for Vibration Studies

(*Continued from page* 45)

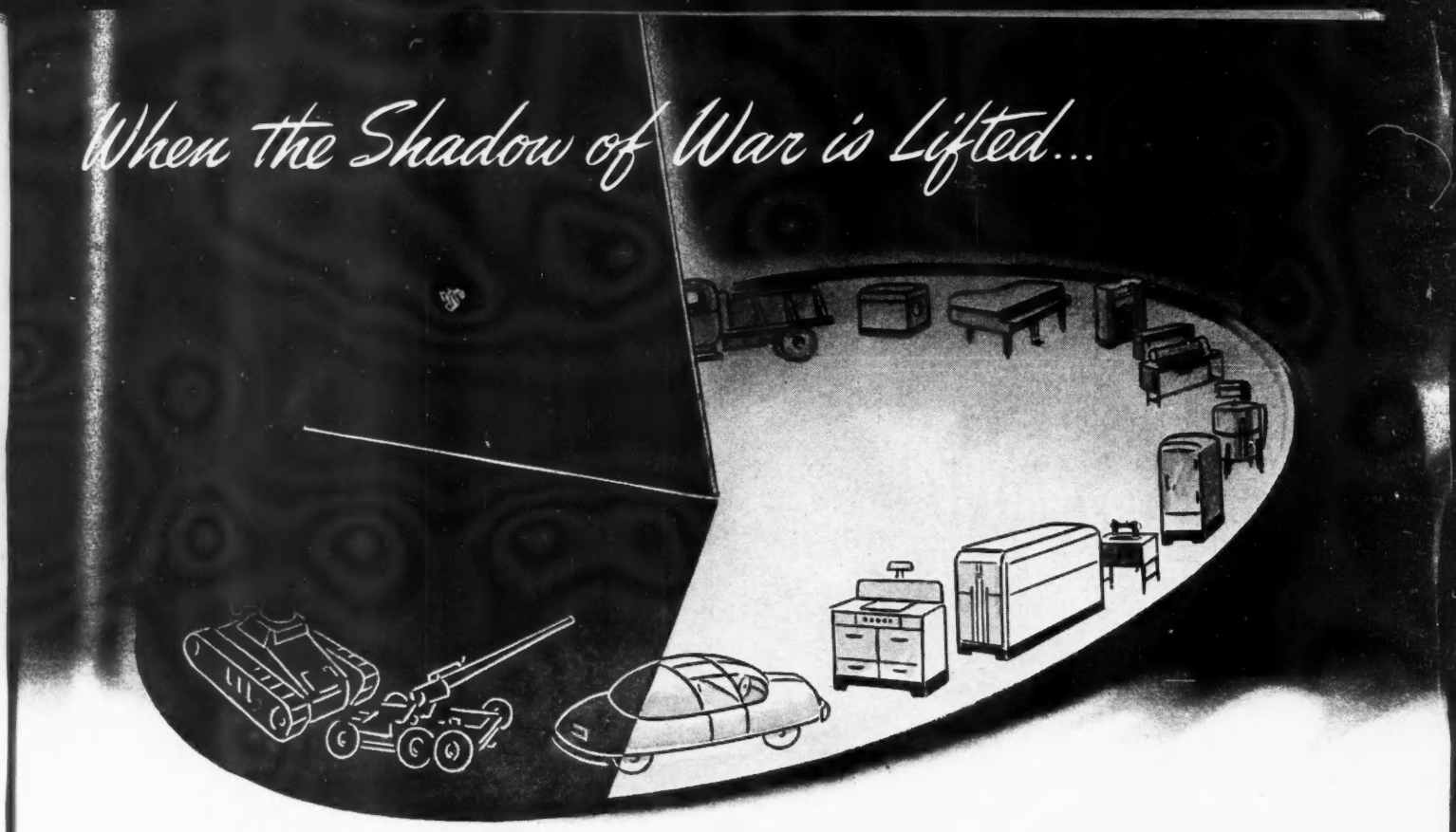
account of, the design may be unnecessarily penalized. To shed light on these problems, an extensive program of tests on large flying boats has been in progress for some time, sponsored jointly by the Glenn L. Martin Company and the Navy Bureau of Aeronautics. A typical installation of testing equipment is shown in Fig. 2.

Acceleration pickups are installed in the wing, hull and tail surfaces, to record translational and rotational accelerations along and about the three principal axes; vertical acceleration of the hull at the tail surfaces, and vertical acceleration of the hull at the bow. The control-surface-displacement indicators consist of wire-wound potentiometers connected in wheatstone bridge circuits whose outputs are directly proportional to the surface displacements. These are recorded by the oscillographs, as are also the responses of strain gages. A typical oscillograph record is reproduced in Fig. 3. A master oscillator signal is recorded as a check on the stability of the electrical equipment. The electrical equipment has been so improved recently that in several cases where landing impacts were sufficiently severe to damage the flight instruments, the former remained perfectly stable. Most of the tests made so far have had for their object to determine landing accelerations on two of the flying boats. So far all of the accelerations measured have been quite low, but rough-water tests are now in progress.

Typical landing acceleration curves are plotted in Fig. 4. These three-dimensional curves represent a record of acceleration distribution. The occurrence of acceleration peaks is characteristic of all landings, and their frequency is largely dependent on the wave formation and frequency of the hull. Large hull amplitudes may be built up when the frequency of the wave formation coincides with one of the natural frequencies of the hull.

The effect of hull flexibility is indicated by the shape of the acceleration curve along the hull span, particularly on the initial impacts. This curve slopes substantially uniformly as far back as the rear step, where it becomes parabolic, in accordance with the hull vertical bending mode. This effect is the more pronounced the greater the length of the hull, and for very long hulls it may prove advantageous to proportion the hull load factor in accordance with the parabolic acceleration distribution shown in Fig. 4.

It is sometimes desirable to measure the loads sustained by landing gears. For instance, several failures of the nose-gear downlock of a medium bomber which occurred recently, pointed to the occurrence of high drag loads. The nose-wheel loads therefore were determined by measuring the strut stresses at four points equally spaced around the periphery, and then computing the loads from the measured stresses and the known nose-wheel geometry. Strain gages were installed on the nose strut as shown in Fig. 5. In order to correlate the nose-gear loads with the applied load factors, four accelerometer pickups were installed along the fuselage at the nose, center of gravity, deck turret, and tail. These tests were carried out on a field in a very rutted condition, representing the most severe conditions ever encountered. Records of the vertical load, drag load, and downlock load during a landing indicated stress reversals in both the drag and the downlock reactions at the fore-and-aft natural bending frequency of the strut. For this particular design the D/V ratio seems to be mostly near 0.8, and the maximum load on the downlock fitting was caused by a vertical load equal to 78 per cent of the design vertical reaction combined with a drag load 60 per cent of the vertical. These results led to the conclusion that the original design load (25 per cent of the vertical reaction) was too low, and at present this load is assumed to be 33 per cent of the vertical reaction.

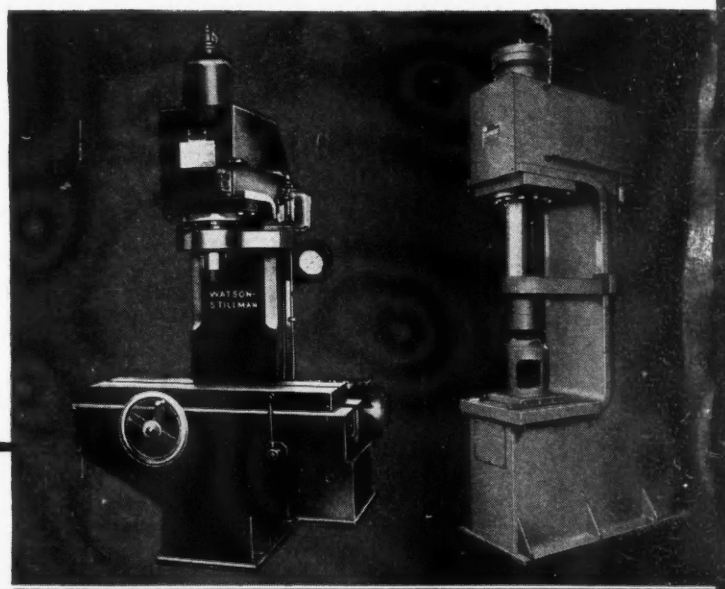


War Busy Presses will do
NEW JOBS HYDRAULICALLY

Some day victory will bring the "cease-firing" order. But it needn't mean "cease-producing" for industries now doing war jobs hydraulically with Watson-Stillman presses. These machines will be adaptable to post-war metal-working operations, and in effecting a rapid, efficient change-over, W-S engineers will be available for special advice.

Their services will put at your disposal hydraulic experience which dates from the eighteen forties. Their suggestions will draw on original research now being carried on. These Watson-Stillman research activities are being expanded in enlarged facilities already under construction.

Watson-Stillman has the modern automatic machinery and the engineering personnel to give practical assistance in planning to meet future requirements. In the post-victory years, the pooled experience of its entire organization can help industry to anticipate its needs correctly. It is not too early now to consult a W-S engineer. The Watson-Stillman Co., Roselle, New Jersey.



To lift war's shadow more quickly Buy

U.S. WAR BONDS

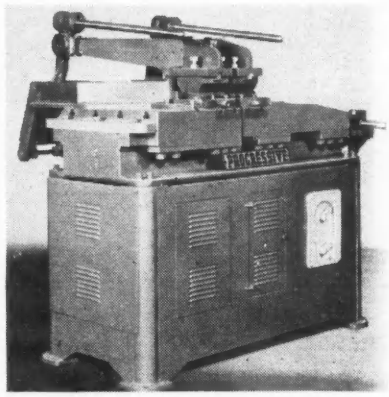
WATSON-STILLMAN

Engineers and Manufacturers of Hydraulic Machinery and Equipment— Hydraulic Presses, Pumps and Jacks, Forged Steel Valves and Fittings

New Production Equipment

(*Continued from page* 38)

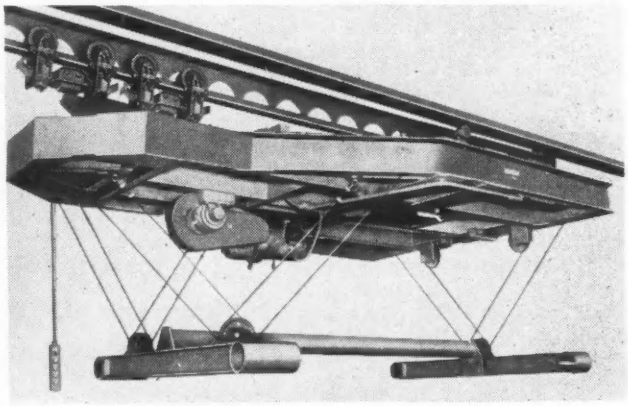
"warns" the machine of an impending short-circuit in the welding arc. The instant this happens, the forward movement of the feed platen is interrupted, the platen jumps back a few thousandths of an inch and then reapproaches. It is claimed that this device makes a possible higher than normal rate of acceleration of the feed platen while performing the weld.



Model C Progressive Flashwelder

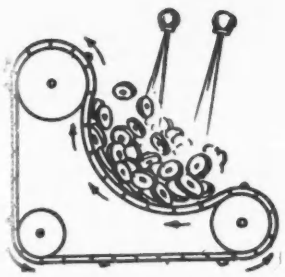
Upsetting speed and pressure are obtained through the use of a single air-hydraulic booster which forces oil into the platen traversing cylinder. Actuation of this air cylinder is by a relay which is tripped when the upset position is reached.

THE new Stabilized Tramrail Carrier, made by The Cleveland Crane & Engineering Company, Wickliffe, Ohio, is said to solve the problem of suspending a load rigidly with the use of flexible hoisting ropes. By an arrangement of the ropes to form a triangular suspension, a load can be held rigidly in place so as to eliminate longitudinal, lateral and rotational sway. If the load should be considerably unbalanced, the carrier will hold it in place. It may be rotated through the use of a trunnion-type load bar. A special feature permits tilting the load when desired.



Tramrail Carrier made by the Cleveland Crane & Engineering Company

A SMALL parts washer, designed around an endless tumbling belt, is a recent development of the American Foundry Equipment Co., Mishawaka, Ind. This batch type machine receives and discharges the parts to be cleaned through a large front opening. It is similar in its action to the rotary drum type cleaning machines in that the work is tumbled to expose all surfaces to the cleaning action of the sprays. The open type barrel gives access to the parts while in process, and the spray system is accessible



Schematic Sectional View of Tumbl-Spray Metal Washing Machine

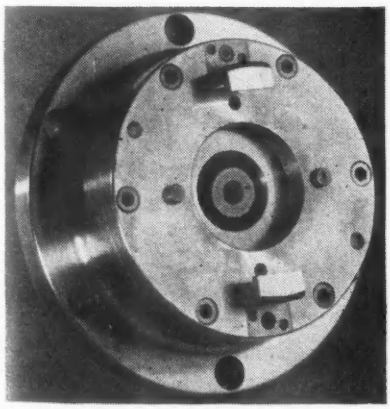
for cleaning and inspecting the pipes and nozzles. To unload the machine, the mill is run in reverse which discharges all parts over a chute.

A WELD cleaning tool that combines a spatter-removing bit and a wire bristle brush in one unit, is being marketed by the Atlas Welding Accessories Company, Detroit,

Atlas Weld Cleaning Tool

Mich., under the trade name "Dual-Tool." A specially developed brush holder permits removal of the brush for reversal or replacement. Interchangeable cone and chisel bits are easily installed.

SPECIAL compensating type finger chucks have been added to the "Airgrip" holding device line of Anker-Holth Manufacturing Co., Chicago, Ill. The design of these chucks permits one finger to pull in farther than the other, to compensate for varying thicknesses of pieces to be held.



Compensating Type Finger Chuck made by Anker-Holth Mfg. Co.

Work pieces are located from a fixed center stop position, and driven by two fixed driving pins. The chuck body is flanged and drilled for direct mounting on the spindle nose.

Airgrip chucks are available in a range of sizes, and are designed to be operated by Anker-Holth high speed revolving air cylinders which are made in sizes from 3 in. to 18 in. inclusive.

Commercial *t*-Butyl Hydroperoxide

(*Continued from page* 46)

ide is said to be ideally adapted for use as a catalytic agent in one or two phase polymerizations, as an oxidation agent for laboratory purposes, as a drying accelerator in oils, paints and varnishes, as a combustion accelerator in heavy fuel oils used in Diesel engines, and as a bleaching agent for cotton, wool and other fabrics.

The familiar Miracle

Look twice. You think you see a negative of two soldiers clashing in bayonet practice. Actually you are looking at sunlight and silver bromide.

The mysterious action of light on certain silver salts is just as much a miracle today as it was a hundred years ago when the first photographs were made.

Hardly less amazing is the remarkable sensitivity of present-day photographic emulsions.

These new films and papers could not be manufactured without exacting control of temperature, control of humidity and protection against dust. *Air conditioning* makes them possible.

Air conditioning and refrigeration play a part in many photographic processes. They are being used to speed up military photography . . . improve all photography.

Today, air conditioning equipment . . . developed by General Electric . . . has been made more compact, more flexible to meet unusual wartime requirements.

After the war, these improvements will result in better air conditioning for offices, stores, theatres, hotels and many other civilian purposes. When the war is won, General Electric will provide this better air conditioning—for a better world.

Air Conditioning and Commercial Refrigeration Department, Division 432, General Electric Co., Bloomfield, New Jersey.

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